FACULTY OF APPLIED SCIENCE AND ENGINEERING

UNIVERSITY OF TORONTO

By order of the Board of Governors, the schedules of fees appearing on the pages of this insert will become effective at the opening of the session 1935-1936, and will replace the schedules appearing in Section VI, 1 to 17 inclusive, pages 19 to 21 inclusive of this calendar.

SECTION VI. FEES AND DEPOSITS

1. Every student in attendance proceeding to a Bachelor's Degree in the Faculty of Applied Science and Engineering is required to pay the following annual fees: Composite, Medical Examination and Physical Training, Hart House (women exempt), Students' Administrative Councils, Engineering Society, and Athletic Association (women exempt). These fees are described in detail below.

2. Special fees are required for matriculation, supplemental examinations, admission ad eundem statum, and degrees.

3. (a) *Students must have paid fees due in the first term before proceeding to the work of the second term. A student will not be admitted to any of the University lectures or laboratory classes who is in arrears for his fees.*

(b) *A student will not be allowed to write any examination if he has not paid all fees for which he is liable at that time.*

COMPOSITE

4. (a) The composite fee, including tuition, library, laboratory supplies (but not laboratory deposits), and one annual examination for each year, shall be as follows:

If paid in full on or before November 5th $225.00

If paid in instalments:—

First instalment, if paid on or before November 5th 113.00

Second instalment, if paid on or before February 5th 115.00

(b) All enrolment fees are payable to the Bursar of the University in advance. After November 5th, a deferred payment fee of $1.00 per month will be imposed until the whole amount is paid. In the case of payment by instalments, the same rule as to the deferred payment fee will apply. A student who is repeating his year is required to pay the same fee as other students.

SUPPLEMENTAL EXAMINATION

5. Candidates for supplemental examinations are required to pay a fee of $10.00 to the Bursar not later than September 1st.

MATRICULATION, OR REGISTRATION OF MATRICULATION

6. Applicants for admission under paragraph 2, (*b*), (*c*), section V, are required to pay to the Bursar a fee of $5.00 for registration of matriculation.

ADMISSION AD EUNDEM STATUM

7. Applicants who are admitted ad eundem statum are required to pay to the Bursar a fee of $10.00.

DEGREES

8. Candidates for the degree of B.A.Sc., or B. Arch., are required to pay to the Bursar by March 15th of their year of graduation, a fee of $10.00.

MEDICAL EXAMINATION AND PHYSICAL TRAINING

9. Every man is required at the opening of each session in which Physical Training is compulsory for such student, to pay to the Bursar the annual fee of $5.00 for medical examination and such subsequent physical training as may be prescribed.

10. Every woman is required to pay a corresponding fee of $4.00.

HART HOUSE

11. Every man is required to pay to the Bursar on or before November 15th the annual fee of $10.00 for membership in Hart House. If this fee is not paid by the above date a deferred payment fee of $2.00 will be imposed.

STUDENTS' ADMINISTRATIVE COUNCILS

12. Every student is required to pay to the Bursar at the time of registration the annual fee, as shown in the summary below, paragraph 16, for the maintenace of the Students' Administrative Councils.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

13. All students in attendance are required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Engineering Society.

14. Each man in attendance is required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Athletic Association of the Faculty.

LABORATORY DEPOSIT

15. A laboratory breakage deposit, to be paid to the Faculty at the time of registration, is required from all students. The amount of the deposit is shown in the summary below. This deposit, less charges for waste, neglect, and breakages, will be refunded by the Secretary at the end of the session. Should the deposit be insufficient to meet the charges, a levy will be made to cover the deficiency.

16. SUMMARY OF FEES AND DEPOSITS

Composite in advance	$225.00 B
in instalments	228.00 B
Supplemental Examinations*	10.00 B
Matriculation, or registration of Matriculation	5.00 B
Degrees (B.A.Sc., B.Arch), payable April 1st	10.00 B
Medical Examination and Physical Training* (men)	5.00 B
Medical Examination and Physical Training* (women)	4.00 B
Hart House (women exempt)	10.00 B
Students' Administrative Councils,	
First, Second and Third Years	2.00 B
Fourth Year	6.00 B
Engineering Society	2.00 F
Athletic Association (women exempt)	2.00 F
Laboratory Deposit, Civil, Mechanical and Electrical Engineering and Architecture	3.00 F
Mining, Chemical and Metallurgical Engineering	8.00 F

Items marked "B" are payable at the office of the Bursar; items marked "F" are payable at the Faculty Office at the time of registration.

All cheques must be made payable to "University of Toronto."

*17. Every student who has neglected to complete satisfactorily the course in Physical Training of the First or Second Year, and who must take this work during a later year, will be required to pay to the Bursar at the opening of that session a supplemental fee of $10.00 in addition to the prescribed Medical Examination fee.

UNIVERSITY OF TORONTO
CALENDAR

FACULTY OF APPLIED SCIENCE
AND
ENGINEERING

1935-1936

THE UNIVERSITY OF TORONTO PRESS

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SECTION I. CALENDAR 1935-1936

MICHAELMAS TERM 1935

July 1 Mon.... Dominion Day. Buildings closed.
July 15 Mon.... Last day for receiving applications for Supplemental Examinations.
Aug. 15 Thur.... Students of the III year, Dept. 1 and 2, report at University Survey Camp.
Sept. 2 Mon.... Labour Day. Buildings closed.
Sept. 7 Sat..... Students of the IV year, Dept. 1, Astronomy option, report at University Survey Camp.
Sept. 10 Tues.... Supplemental Examinations commence.
Sept. 19 Thur.... Special meeting of Faculty Council.
Sept. 23 Mon.... Registration in person of the I year from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.
Students in Architecture of the II, III, and IV years report at University Survey Camp.
Sept. 24 Tues.... Registration in person of the II and III years (except Architecture) from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.
The Dean's address to the I year at 9.00 a.m. in Room 38, Engineering Building.
Preliminary instruction and classification tests for the I year in Room 38, Engineering Building.
Meeting of Faculty Council.
Sept. 25 Wed.... Lectures and laboratory work commence.
Registration in person of the IV year (except Architecture), and the V year in Architecture, from 9.00 a.m. to 1.00 p.m.
The opening address by the President to the students of all faculties at 4.00 p.m. in Convocation Hall.
Sept. 28 Sat..... Stated meeting of the Caput to deal with requests as to social functions until November 15.
Oct. 1 Tues.... Inaugural meeting of Faculty Council.
Oct. 2 Wed.... Registration in person of II, III, and IV years in Architecture at the Faculty Office.
Oct. 11 Fri..... Meeting of Senate.
Oct. 14 Mon.... Thanksgiving Day. Buildings closed.
Oct. 15 Tues.... First meeting of Engineering Society.
Oct. 18 Fri..... Intercollegiate Track Meet. Neither lectures nor laboratory classes given after 1.00 p.m.
Oct. 28 Mon.... Meeting of Engineering Society.
Nov. 1 Fri..... Meeting of Faculty Council.

Nov. 8 Fri.....Meeting of Senate.
Nov. 11 Mon....Remembrance Day. Service at the Soldiers' Tower at 11.00 a.m. Neither lectures nor laboratory classes given from 10.40 a.m. to 11.15 a.m.
Nov. 13 Wed....Meeting of Engineering Society.
Nov. 28 Thur....Meeting of Engineering Society.
Dec. 2 Mon....Meeting of Faculty Council.
Dec. 13 Fri.....Meeting of Senate.
Meeting of Engineering Society.
Dec. 20 Fri.....Michaelmas term ends at 12.00 noon.
Dec. 25 Wed....Christmas Day. Buildings closed.

EASTER TERM 1936

Jan. 1 Wed....New Year's Day. Buildings closed.
Jan. 6 Mon....Easter Term begins.
Mid-session Examinations commence.
Meeting of Faculty Council.
Jan. 10 Fri.....Meeting of Senate.
Jan. 13 Mon....Meeting of Engineering Society.
Jan. 21 Tues....Special Meeting of Faculty Council.
Jan. 28 Tues....Meeting of Engineering Society.
Feb. 3 Mon....Meeting of Faculty Council.
Feb. 13 Thur....Meeting of Engineering Society.
Feb. 14 Fri.....Meeting of Senate.
Feb. 26 Wed....Meeting of Engineering Society.
Feb. 28 Fri.....Engineering Society Annual Elections.
Mar. 2 Mon....Meeting of Faculty Council.
Mar. 9 Mon....Engineering Society Annual General Meeting.
Mar. 13 Fri.....Meeting of Senate.
Apr. 1 Wed....Meeting of Faculty Council.
Apr. 8 Wed....Easter Term ends at 5.00 p.m.
Apr. 9 Thur....Meeting of Senate.
Apr. 10-13 Fri.-Mon..Easter. Buildings closed.
Apr. 14 Tues....Annual Examinations commence.
May 1 Fri.....Meeting of Faculty Council.
May 8 Fri.....Meeting of Senate.
May 25 Mon....Victoria Day. Buildings closed.
June 3 Wed....Meeting of Senate.
June 4-5 Thur.-Fri..University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

1934-1935

THE UNIVERSITY

President.........THE HON. AND REV. H. J. CODY, M.A., D.D., LL.D.
Registrar..............................A. B. FENNELL, M.C., M.A.
Bursar...................................F. A. MOURÉ, MUS. DOC.
Librarian...................................W. S. WALLACE, M.A.
Superintendent of Buildings and Grounds......... A. D. LEPAN, B.A.SC.
Director of University Extension and Publicity..W. J. DUNLOP, B.A., B.PAED.
Warden of Hart House.................J. B. BICKERSTETH, M.C., M.A.
Director of University Health Service................G. D. PORTER, M.B.
Medical Adviser for Women Students..MISS E. GORDON, B.A., M.B., D.P.H.
Manager of the University of Toronto Press.........R. J. HAMILTON, B.A.

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean.......C. H. MITCHELL, C.B., C.M.G., D.S.O., C.E., LL.D., D.Eng.
Secretary............................W. S. WILSON, B.A.SC., M.E.I.C.

INQUIRIES

Inquiries about admission to the Faculty of Applied Science and Engineering should be sent to the Registrar of the University.

Communications relating to curriculum, instruction and examinations, in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information about opportunities for graduates of this Faculty, reference may be made to a pamphlet issued by the Director of University Extension and Publicity entitled "Opportunities for Graduates of Applied Science and Engineering."

SECTION III. TEACHING STAFF

PROFESSORS

E. A. Allcut, M.Sc. (B'ham.), M.E. (Tor.), M.I.Mech.E. 48 Foxbar Rd.
Professor of Mechanical Engineering.

G. R. Anderson, M.A., A.M. (Har.), M.I.E.S., F.A.S.A. 7 Rose Park Cr.
Professor Emeritus of Engineering Physics and Photography.

R. W. Angus, B.A.Sc., M.E., M.E.I.C., M.A.S.M.E. Mechanical Bldg.
Professor of Mechanical Engineering.

E. G. R. Ardagh, B.A.Sc., F.C.I.C., F.R.S.C. 80 Strathallan Blvd.
Professor of Applied Chemistry.

E. R. Arthur, B.Arch., M.A. (Liverpool), A.R.I.B.A. 163 Walmer Rd.
Professor of Architecture.

J. W. Bain, B.A.Sc., F.I.C., F.R.S.C. 393 Brunswick Ave.
Professor of Chemical Engineering.

E. W. Banting, B.A.Sc. 101 Farnham Ave.
Associate Professor of Civil Engineering: Surveying and Geodesy.

M. C. Boswell, B.A.Sc., M.A. (Har.), Ph.D., F.R.S.C. Mining Bldg.
Professor of Organic Chemistry (in Chemical Engineering).

H. J. Burden, D.S.O., D.F.C., B.A.Sc., M.F.A. (Princ.)
Assistant Professor of Architecture. 26 Old Forest Hill Rd.

J. R. Cockburn, M.C., V.D., B.A.Sc., M.E.I.C. 100 Walmer Rd.
Professor of Descriptive Geometry.

S. R. Crerar, B.A.Sc., D.L.S. 122 Grenadier Rd.
Associate Professor of Surveying.

W. B. Dunbar, B.A.Sc., A.M.E.I.C. 241 Glebeholme Blvd.
Assistant Professor of Engineering Drawing.

F. C. Dyer, B.A.Sc., M.E.I.C. 164 Colin Ave.
Associate Professor of Mining Engineering.

G. A. Guess, M.A. (Qu.) Oakville, Ont.
Professor of Metallurgical Engineering.

H. E. T. Haultain, C.E., M.E.I.C. 156 Glencairn Ave.
Professor of Mining Engineering.

K. B. Jackson, B.A.Sc. 362 Glengrove Ave. W.
Assistant Professor of Applied Physics.

J. T. King, B.A.Sc. 126 Manor Rd. E.
Associate Professor of Mining Engineering.

A. T. Laing, B.A.Sc. 146 Balmoral Ave.
Associate Professor of Highway Engineering (retired).

T. R. Loudon, B.A.Sc., M.E.I.C. 189 Sheldrake Blvd.
Professor of Applied Mechanics.

W. G. McIntosh, B.A.Sc. 105 Bedford Rd.
Assistant Professor of Mechanical Engineering.

R. R. McLaughlin, M.A.Sc., M.A., Ph.D. — 36 Douglas Dr.
Assistant Professor of Chemical Engineering.

H. H. Madill, V.D., B.A.Sc., F.R.A.I.C. — 47 Eastbourne Ave.
Professor of Architecture.

J. W. Melson, B.A.Sc. — 69 Walmsley Blvd.
Assistant Professor of Civil Engineering: Surveying and Geodesy.

R. J. Montgomery, B.Sc., Cer.E. (Ohio) — 7 Cottingham Rd.
Associate Professor of Ceramics.

J. A. Newcombe, B.Sc. (London), A.R.S.M. — 163 Mortimer Ave.
Associate Professor of Metallurgy.

H. W. Price, B.A.Sc. — 40 Ava Rd.
Professor of Electrical Engineering.

T. R. Rosebrugh, M.A., F.R.S.C. — 92 Walmer Rd.
Professor of Electrical Engineering.

E. A. Smith, M.A. (McM.) — 46 Collegeview Ave.
Assistant Professor of Chemical Engineering.

V. G. Smith, B.A.Sc. — 49 Nealon Ave.
Assistant Professor of Electrical Engineering.

W. J. Smither, B.A.Sc., M.E.I.C. — 35 Wilberton Rd
Associate Professor of Structural Engineering.

L. B. Stewart, D.T.S. — Whitby, Ont.
Professor Emeritus of Surveying and Geodesy.

R. Taylor, B.A.Sc. — 82 Glen Echo Rd.
Associate Professor of Mechanical Engineering.

J. E. Toomer, B.Sc. (N. Carolina) — 152 St. George St.
Assistant Professor of Metallurgy.

W. M. Treadgold, B.A. — 13 Woodlawn Ave. E.
Professor of Civil Engineering: Surveying and Geodesy.

C. H. C. Wright, B.A.Sc., M.R.A.I.C. — 419 Markham St.
Professor Emeritus of Architecture.

W. J. T. Wright, M.B.E., B.A.Sc. — 126 Melrose Ave.
Associate Professor of Engineering Drawing.

C. R. Young, B.A.Sc., C.E., M.E.I.C. — 119 Glenayr Rd.
Professor of Civil Engineering: Municipal and Structural.

A. R. Zimmer, B.A. Sc. — 80 Pine Crest Rd.
Associate Professor of Electrical Engineering.

LECTURERS

B. de F. Bayly, B.A.Sc. — 227 Roehampton Ave.
Lecturer in Electrical Engineering.

A. E. Berry, M.A.Sc., C.E., Ph.D. — 235 Gainsborough Rd.
Special Lecturer in Municipal Engineering.

R. J. Brown, B.A.Sc. — 272 Beresford Ave.
Lecturer in Electrical Engineering.

W. E. CARSWELL, B.Arch. 419 Markham St.
Lecturer in Architecture.

T. L. CROSSLEY., A.M.E.I.C. 28 Lonsdale Rd.
Special Lecturer in Pulp and Paper.

H. B. DUNNINGTON-GRUBB 4 St. Thomas St.
Special Lecturer in Architecture.

T. C. GRAHAM, B.A.Sc. 145 St. Germain Ave.
Lecturer in Mechanical Engineering.

R. R. GRANT, O.L.S., C.A. 58 Poplar Plains Rd.
Special Lecturer in Accountancy and Business.

G. H. HALLY, B.A.Sc. Aurora
Lecturer in Mechanical Engineering.

P. V. JERMYN, B.A.Sc., M.E.I.C. 109 Cluny Dr.
Lecturer in Engineering Drawing.

F. H. KIRKPATRICK, Ph.B. (Hiram) 157 Alexandra Blvd.
Special Lecturer in Public Speaking.

R. E. LAIDLAW, B.A.Sc. 11 Dewbourne Ave.
Special Lecturer in Engineering Law.

M. J. C. LAZIER, B.A.Sc. Port Credit
Lecturer in Applied Mechanics.

G. R. LORD, B.A.Sc., S.M. (M.I.T.) 5 Cottingham Rd.
Lecturer in Mechanical Engineering.

A. S. MATHERS, B.A.Sc. 110 Highbourne Rd.
Special Lecturer in Architecture.

C. F. MORRISON, B.E. (Sask.), M.Sc. (McG.) 394 Avenue Rd.
Lecturer in Civil Engineering: Municipal and Structural.

W. L. SAGAR, B.A.Sc., A.M.E.I.C. 38 Melrose Ave.
Lecturer in Civil Engineering: Municipal and Structural.

J. J. SPENCE, A.M.E.I.C. 162 Glencairn Ave.
Lecturer in Engineering Drawing.

A. WARDELL, B.A.Sc., 124 Melrose Ave.
Lecturer in Engineering Drawing.

R. C. WIREN, B.A.Sc. East House, University Residence
Lecturer in Mechanical Engineering.

INSTRUCTORS

H. BOESCHENSTEIN, Ph.D. (Rostock) 83 Cranbrooke Ave.
Instructor in Technical German.

C. A. BOOTH, B.A.Sc. 161 Hopedale Ave.
Instructor in Applied Physics.

R. M. CLARK, B.A.Sc. 44 Willcocks St.
Instructor in Engineering Drawing.

F. COATES, A.R.C.A. Scarborough Bluffs
Instructor in Modelling.

G. R. EDWARDS, B.A.Sc. 1263 King St. W.
Instructor in Engineering Drawing.

A. M. FITZGERALD, B.A.Sc. Apt. 9, 40 Hazelton Ave.
Instructor in Chemical Engineering.

V. L. HENDERSON, B.A.Sc. 116 Wells St.
Instructor in Applied Physics.

C. W. JEFFERYS, R.C.A., O.S.A., LL.D.(Qu.) 4111 Yonge St., York Mills, Ont.
Instructor in Painting.

MISS J. C. LAING, B.A. 20 Williamson Rd.
Librarian and Instructor in Architectural History and French.

T. L. ROWE 104 Braemore Gardens
Instructor in Civil Engineering: Surveying and Geodesy.

MACKENZIE WATERS, M.C., B.A.Sc. 267 Roxborough St. E.
Special Instructor in Architectural Design.

S. E. WOLFE, M.A.Sc. Streetsville
Instructor in Mining Engineering.

DEMONSTRATORS

J. E. ANDERSON, B.A.Sc. 410 Huron St.
Demonstrator in Mining Engineering.

G. P. BEAL, M.A.Sc. 68 Lakeview Ave.
Demonstrator in Chemical Engineering.

J. W. BELL, B.A.Sc. 20 Hurndale Ave.
Demonstrator in Electrical Engineering.

W. H. BOWMAN, B.A.Sc. 622 Dovercourt Rd.
Demonstrator in Chemical Engineering.

J. G. BRECKENRIDGE, B.A.Sc., Ph.D. (Camb.) 21 Cluny Ave.
Demonstrator in Chemical Engineering.

J. M. CARSWELL, B.A.Sc. 111 Spruce Hill Rd.
Demonstrator in Engineering Drawing.

J. R. CRERAR, B.A.Sc. 122 Grenadier Rd.
Demonstrator in Machine Design.

W. H. DE MONTMORENCY, B.A.Sc. 134 Albany Ave.
Demonstrator in Chemical Engineering.

G. T. EATON, M.A. (McM.), B.Sc. (Ac.) 32 Walmer Rd.
Demonstrator in Chemical Engineering.

F. G. EWENS, B.A.Sc. Apt. 3, 83 Madison Ave.
Demonstrator in Thermodynamics.

W. W. FAWCETT, B.A.Sc. 62 St. Ann's Rd.
Demonstrator in Engineering Drawing.

D. H. HAMLY, M.A., Ph.D. 106 Keewatin Ave.
Demonstrator in Applied Physics.

C. E. HELWIG, B.A.Sc. 35 Montye Ave.
Demonstrator in Civil Engineering: Municipal and Structural.

W. G. HESLOP, B.A.Sc. 8 Harbord St.
Demonstrator in Civil Engineering: Surveying and Geodesy.

D. T. HEWSON, B.A.Sc. 23 Fernwood Park Ave.
Demonstrator in Thermodynamics.

J. HVILIVITZKY, B.A.Sc. 16 Harbord St.
Demonstrator in Engineering Drawing.

W. J. JACKSON, M.A.Sc. 1 Washington Ave.
Demonstrator in Applied Physics.

G. V. JANSEN, M.A.Sc. 107 Avenue Rd.
Demonstrator in Chemical Engineering.

S. C. D. LAWSON, B.A.Sc. Eglinton Ave. E.,
Demonstrator in Machine Design. Leaside, Ont.

J. A. MCMILLAN, B.A.Sc. 67 Madison Ave.
Demonstrator in Thermodynamics.

W. E. MICKLETHWAITE, B.A.Sc. 886 Ossington Ave.
Demonstrator in Hydraulics.

V. S. J. MILLARD, B.A.Sc. 376 Manor Rd. E.
Demonstrator in Thermodynamics.

C. A. NORRIS, B.A.Sc. 374 Huron St.
Demonstrator in Electrical Engineering.

J. C. R. PUNCHARD, B.A.Sc. 405 Kingston Rd.
Demonstrator in Electrical Engineering.

W. H. RAPSON, B.A.Sc. 6 Edgewood Gdns.
Demonstrator in Chemical Engineering.

J. E. REID, B.A.Sc. 80 Madison Ave.
Demonstrator in Electrical Engineering.

J. R. RENWICK, B.A.Sc. 138 Avenue Rd.
Demonstrator in Hydraulics.

P. A. RICKARD, B.A.Sc. 268 St. George St.
Demonstrator in Electrical Engineering.

H. R. SUMNER, B.A.Sc. 327 Lauder Ave.
Demonstrator in Electrical Engineering.

J. R. TURNBULL, B.A.Sc. Apt. 38, 435 Sherbourne St.
Demonstrator in Electrical Engineering.

M. WARD, B.A.Sc. 80 Madison Ave.
Demonstrator in Electrical Engineering.

M. BARRY WATSON, B.A.Sc., C.E., M.E. 121 Welland Ave.
Demonstrator in Engineering Drawing.

W. B. WHALLEY, B.A.Sc. 81 Glenmount Park Rd.
Demonstrator in Electrical Engineering.

C. W. WOODSIDE, B.A.Sc. 312 Huron St.
Demonstrator in Engineering Drawing.

PROFESSORS OF OTHER FACULTIES GIVING INSTRUCTION TO STUDENTS IN APPLIED SCIENCE

F. C. AULD, B.A. (McG.), M.A., B.C.L. (Ox.) — 21 Poplar Plains Cres.
Lecturer in Commercial Law.

S. BEATTY, M.A., Ph.D., F.R.S.C. — 537 Markham St.
Professor of Mathematics.

J. D. BURK, B.A. — 30 Duggan Ave.
Assistant Professor of Mathematics.

J. T. BURT-GERRANS, Phm. B., M.A., Ph.D. — 46 Dewson St.
Associate Professor of Electrochemistry.

E. F. BURTON, B.A. (Tor.), (Camb.), Ph.D., F.R.S.C.
Professor of Physics. — 224 Queens Drive, Weston

J. B. FERGUSON, B.A., F.R.S.C. — 100 Albertus Ave.
Associate Professor of Chemistry.

L. GILCHRIST, M.A., Ph.D. (Chic.), F.R.S.C. — North House, U. of T.
Professor of Physics.

F. B. KENRICK, M.A., Ph.D. (Leip.), F.R.S.C. — 77 Lonsdale Rd.
Professor of Chemistry.

A. MACLEAN, B.A. — 488 Spadina Ave.
Professor of Geology.

W. L. MILLER, B.A., Ph.D. (Munich), F.R.S.C. — 8 Hawthorne Ave.
Professor of Physical Chemistry.

E. S. MOORE, M.A., Ph.D. (Chic.), F.R.S.C. — 18 Indian Grove
Professor of Economic Geology.

W. A. PARKS, B.A., Ph.D., F.R.S.C. — 88 Prince Arthur Ave.
Professor of Geology.

A. L. PARSONS, A.B., (N.Y.) — 67 Oriole Gardens
Professor of Mineralogy.

I. R. POUNDER, M.A., Ph.D. (Chic.) — 19 Glen Gordon Rd.
Associate Professor of Mathematics.

D. A. F. ROBINSON, M.A., Ph.D. (Chic.) — 592 University Ave.
Assistant Professor of Mathematics.

G. DEB. ROBINSON, B.A., Ph.D. (Camb.) — 119 Collier St.
Assistant Professor of Mathematics.

L. J. ROGERS, B.A.Sc., M.A. — 110 Garfield Ave.
Associate Professor of Chemistry.

J. SATTERLEY, M.A. (Camb.), D.Sc. (Lond.), F.R.S.C. — 95 Bernard Ave.
Professor of Physics.

J. L. SYNGE, M.A., Sc.D. (Dub.), F.R.S.C. — 54 Radford Ave.
Professor of Applied Mathematics.

J. E. THOMSON, B.A.Sc., Ph.D. (Har.), F.R.S.C. — 123 Welland Ave.
Professor of Mineralogy.

T. L. WALKER, M.A. (Qu.), Ph.D. (Leip.), F.R.S.C. — 20 Avondale Ave.
Professor of Mineralogy and Petrography.

R. K YOUNG, B.A., Ph.D. (Cal.), F.R.S.C. — 11 Madison Ave.
Professor of Astronomy.

SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate by statute, subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909-1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910-1911. In the session 1923-1924 the Degree of B.Arch. was offered to students in Architecture.

SECTION V. ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

GENERAL

1. Candidates for admission to the Faculty of Applied Science and Engineering must submit evidence to show that they are qualified to take one of the courses of instruction and proceed to a degree. Applicants must also submit a certificate of good character, and must have completed the seventeenth year of their age. The procedure for application and registration is described in paragraph 8 below.

2. In general, the holding of any of the following classes of certificate will constitute qualification for admission to this Faculty.

(*a*) Certificates of Ontario Pass and Honour Matriculation as described in paragraph 3 below.

(*b*) Certificates of having passed certain equivalent examinations as described in paragraph 5 below.

(*c*) Certificates of undergraduate work in other universities. See admission ad eundem statum, paragraphs 6 and 7 below.

The Senate will consider applications for the recognition of certificates other than those mentioned as occasion may require. Such certificates must be accompanied by an official statement of the marks in the various subjects upon which the certificate was granted.

ONTARIO MATRICULATION

3. Certificates of Ontario Matriculation for admission to the Faculty of Applied Science and Engineering must cover complete Pass Matriculation, and five subjects of Honour Matriculation.

PASS MATRICULATION

Complete Pass Matriculation will consist of these subjects:

English (Literature and Composition)
History (Canadian and Ancient), or Canadian History and Music,
Mathematics (Algebra and Geometry),
And three of: Greek (Authors and Accidence),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition), or
Spanish (Authors and Composition),
Science (Physics or Agriculture Part I, and Chemistry or Agriculture Part II),
Arithmetic with Mechanical Drawing* and Shop Work.*

*Credit in Mechanical Drawing and Shop Work will consist of certificates from the Principal of the School, accompanied by an approving certificate from the Director of the Technical School Branch of the Department of Education for Ontario. This option applies to students—and to such students only—who have been in attendance at, and matriculate from, a Technical School in the Province of Ontario and are so certified by the Department of Education of the Province

HONOUR MATRICULATION

Honour Matriculation will consist of these subjects:

English (Literature and Composition),
Algebra and Geometry,†
Trigonometry,†
Science (Physics and Chemistry),
And one of Greek (Authors and Composition),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition),
Spanish (Authors and Composition).

†Admission to the Department of Engineering Physics will be granted only to those who have met the regular requirements for admission to the Faculty of Applied Science and Engineering and, in addition, have obtained an average of 75 per cent. in the Mathematics (Algebra, Geometry, and Trigonometry) of the Honour Matriculation Examination.

4. Those intending to enter the course in Architecture are recommended to select French as one of the Matriculation subjects; those intending to enter Chemical, Civil, or Mechanical Engineering or Engineering Physics are recommended to select German; while those intending to enter Metallurgical Engineering are advised to select Spanish.

EQUIVALENT EXAMINATIONS

5. Certificates of the following examinations recognized as equivalent in value to the Ontario Matriculation, Pass, or Honour may be accepted as far as they meet the Ontario requirements in subjects and percentages. A candidate applying for admission on such certificates must submit an official statement of the marks upon which these certificates were awarded.

Province of Ontario

Middle School or Upper School examinations or examinations of the same standard under other names.

Province of Quebec

‡High School Leaving Certificate examination.

‡*Of Pass Matriculation standard only.*

Province of New Brunswick

Grammar School or First Class Licenses; also the Superior, except for Latin.

Province of Nova Scotia

High School Certificates of Grade XI and Grade XII issued by the Department of Education.

Province of Manitoba

Grade XI and Grade XII examinations.

Province of British Columbia

Junior and Senior Matriculation examinations.

Province of Prince Edward Island

First Class Licence Certificates issued either by the Education Department or Prince of Wales College; Honour Diplomas issued by the above College.

Province of Alberta

Grade XI and Grade XII examinations.

Province of Saskatchewan

Grade XI and Grade XII examinations.

Newfoundland and the Maritime Provinces

Certificate of the Common Examining Board, Junior and Senior Associate Diplomas of the Department of Education of Newfoundland.

Great Britain

Certificate of having passed, or having exemption from, the Preliminary Examination of the Institution of Civil Engineers in the British Isles, or equivalent.

ADMISSION AD EUNDEM STATUM

6. An undergraduate of another university may be admitted ad eundem statum on such conditions as the Senate, on the recommendation of the Council of the Faculty, may prescribe.

7. An applicant for admission ad eundem statum must submit with his application for admission: (1) an official transcript of his record in the University from which he wishes to transfer, showing in detail the courses which he has completed with his standing in each; (2) certificate of honourable dismissal; (3) certificate of vaccination; and (4) calendar of the university giving a full description of these courses.

PROCEDURE FOR APPLICATION AND REGISTRATION

8. Candidates for admission should apply to the Registrar of the University for forms of applications for admission; they are required to fill in these forms in duplicate and return them to the Registrar *not later than* September 10th, together with the following: (*a*) all Pass and Honour Matriculation or equivalent certificates which they may hold; (*b*) any other evidence of ability to take the work proposed; (*c*) certificate of good

character; (*d*) certificate of vaccination. Failure to make early application will result in delay and inconvenience for the candidate.

9. By order of the Board of Governors, all candidates for admission must submit a certificate of successful vaccination with their application, or agree to submit such certificate within ten days after the opening of the session. The Directors of the University Health Services will arrange for the vaccination of those who so desire.

10. Students of all years are required to register in person with the Secretary of the Faculty *on the date specified on page 5 of the Calendar.*

11. Students who present themselves on subsequent days must petition the Council to be allowed to register, and Council reserves the right to reject the applications of, or impose penalties upon, those who fail to register on the date specified.

12. Every petition for registration subsequent to the prescribed day must be accompanied by a sum of money reckoned at one dollar per diem for each day thereafter. For sufficient cause the whole or part of such sum may be refunded.

SECTION VI. FEES AND DEPOSITS

1. Every student in attendance proceeding to a Bachelor's Degree in the Faculty of Applied Science and Engineering is required to pay the following annual fees: Enrolment (tuition), Medical Examination, Hart House (women exempt), Students' Administrative Councils, Engineering Society, and Athletic Association (women exempt). These fees are described in detail below.

2. Special fees are required for matriculation, supplemental examinations, admission ad eundem statum, and degrees.

3. (a) *Students must have paid fees due in the first term before proceeding to the work of the second term. A student will not be admitted to any of the University lectures or laboratory classes who is in arrears for his fees.*

(b) *A student will not be allowed to write any examination if he has not paid all fees for which he is liable at that time.*

ENROLMENT (TUITION)

4. (a) The enrolment fee, including tuition, library, laboratory supplies and one annual examination for each year, shall be as follows:

If paid in full on or before November 5th..................$200.00
If paid in instalments:—
First instalment, if paid on or before November 5th..... 100.00
Second instalment, if paid on or before February 5th.... 103.00

(b) All enrolment fees are payable to the Bursar of the University in advance. After November 5th, a deferred payment fee of $1.00 per month will be imposed until the whole amount is paid. In the case of payment by instalments, the same rule as to the deferred payment fee will apply. A student who is repeating his year is required to pay the same fee as other students.

SUPPLEMENTAL EXAMINATION

5. Candidates for supplemental examinations are required to pay a fee of $10.00 to the Bursar not later than September 1st.

MATRICULATION, OR REGISTRATION OF MATRICULATION

6. Applicants for admission under paragraph 2, (*b*), (*c*), section V, are required to pay to the Bursar a fee of $5.00 for registration of matriculation.

ADMISSION AD EUNDEM STATUM

7. Applicants who are admitted ad eundem statum are required to pay to the Bursar a fee of $10.00.

DEGREES

8. Candidates for the degree of B.A.Sc., or B. Arch., are required to pay to the Bursar by March 15th of their year of graduation, a fee of $10.00.

MEDICAL EXAMINATION AND PHYSICAL TRAINING

9. Every man is required at the opening of each session in which Physical Training is compulsory for such student, to pay to the Bursar the annual fee of $5.00 for medical examination and such subsequent physical training as may be prescribed.

10. Every woman is required to pay a corresponding fee of $4.00.

HART HOUSE

11. Every man is required to pay to the Bursar on or before November 15th the annual fee of $10.00 for membership in Hart House. If this fee is not paid by the above date a deferred payment fee of $2.00 will be imposed.

STUDENTS' ADMINISTRATIVE COUNCILS

12. Every student is required to pay to the Bursar at the time of registration the annual fee, as shown in the summary below, paragraph 17, for the maintenace of the Students' Administrative Councils.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

13. All students in attendance are required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Engineering Society.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

14. Each man in attendance is required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Athletic Association of the Faculty.

LABORATORY DEPOSIT

15. A laboratory breakage deposit, to be paid to the Faculty at the time of registration, is required from all students. The amount of the deposit is shown in the summary below. This deposit, less charges for waste, neglect, and breakages, will be refunded by the Secretary at the end of the session. Should the deposit be insufficient to meet the charges, a levy will be made to cover the deficiency.

16. SUMMARY OF FEES AND DEPOSITS

Enrolment (tuition) in advance	$200.00 B
in instalments	203.00 B
Supplemental Examinations*	10.00 B
Matriculation, or registration of Matriculation	5.00 B
Degrees (B.A.Sc., B.Arch), payable April 1st	10.00 B
Medical Examination and Physical Training* (men)	5.00 B
Medical Examination and Physical Training* (women)	4.00 B
Hart House (women exempt)	10.00 B
Students' Administrative Councils,	
First, Second and Third Years	2.00 B
Fourth Year	6.00 B
Engineering Society	2.00 F
Athletic Association (women exempt)	2.00 F
Laboratory Deposit, Civil, Mechanical and Electrical Engineering and Architecture	3.00 F
Mining, Chemical and Metallurgical Engineering	8.00 F

Items marked "B" are payable at the office of the Bursar; items marked "F" are payable at the Faculty Office at the time of registration.

All cheques must be made payable to "University of Toronto."

*17. Every student who has neglected to complete satisfactorily the course in Physical Training of the First or Second Year, and who must take this work during a later year, will be required to pay to the Bursar at the opening of that session a supplemental fee of $10.00 in addition to the prescribed Medical Examination fee.

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating department, or school in which he intends to proceed to a degree. There are seven departments in Engineering and the School of Architecture from which the selection may be made; viz.,

Civil Engineering (Dept. 1),
Mining Engineering (Dept. 2),
Mechanical Engineering (Dept. 3),
Architecture (Dept. 4),
Engineering Physics (Dept. 5),
Chemical Engineering and Applied Chemistry (Dept. 6),
Electrical Engineering (Dept. 7),
Metallurgical Engineering (Dept. 8).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the courses in Engineering; and Bachelor of Architecture, to those who complete the course in Architecture.

3. The courses in Engineering extend over four academic years; the course in Architecture extends over five. A student must pass in the work of each academic year before proceeding to the work of the next. See p. 109, para. 3.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction in Engineering and Architecture are given in Sec. IX, p. 24.

7. Examinations are conducted as explained in Sec. X, p. 109.

8. Students in Mining and Mechanical Engineering, Architecture, and Electrical Engineering are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. See Sec. IX, p. 29, 33, 36 and 103.

9. Graduates in Engineering and Architecture may proceed to post graduate and professional degrees. The post graduate degrees include M. Arch., M.A.Sc., Ph.D.; and the professional degrees, C.E., Chem. E., E.E., M.E. (Mechanical Engineer), M.E. (Mining Engineer), and Met. E. The courses for these degrees are under the direction of the School of Graduate Studies, and candidates should send their inquiries to the Secretary of the School of Graduate Studies. Some of the requirements of these courses are given in an appendix to this Calendar.

SECTION VIII. SCHOOL OF ENGINEERING RESEARCH

THE SCHOOL

A School of Engineering Research, within the Faculty of Applied Science and Engineering, was established in the Spring of 1917 at the suggestion of the late Dean Ellis.

The School is under the direct supervision of a Committee of Management composed of fifteen members of the Faculty Council. To this Committee of the Council is entrusted the selection of researches to be undertaken under the auspices of the School, and the disposition of funds for conducting them.

The School was organized chiefly for the training of graduates in methods of research, and for the carrying out of investigations. These latter may be problems relating to specific industries or raw materials and having a specific end in view, or general problems having to do with fundamental principles.

RESEARCH ASSISTANTS

A number of research assistants in the School of Engineering Research are appointed annually on salary in the various departments of the Faculty to carry on the work of research under direction of members of the staff. This work is accepted as partial fulfilment of the requirements for the degrees of M.A.Sc.,M.Arch. and Ph.D. These research assistants are usually recent graduates, and are chosen from among those who have displayed special capacity for investigation in their undergraduate courses. Applicants should consult with members of the staff as soon as possible after the April examinations.

The facilities of the School are also open to graduates who desire to penetrate more deeply into particular phases of experimental work, or to undertake investigations either suggested by members of the staff or arising from their own work since graduation.

INQUIRIES

All communications should be sent to the secretary, Professor M. C. Boswell, Ph.D.

SECTION IX. CURRICULUM

The courses of instruction are designed to give the student a thorough grounding in the fundamentals of engineering or architecture; and, in addition, sufficient familiarity with the practical application of the principles to make him useful upon graduation. The courses are very similar in the First Year with the exception of those of Architecture, Engineering Physics and Chemical Engineering. In the succeeding years specialization develops to some extent with provision in the Third and Fourth years for optional courses in some of the graduating departments.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As the future engineer is vitally concerned with the development of the country, it is essential that he be instructed in the rudiments of economics, administration, and business, which, with his scientific training, will enable him to increase his usefulness to the full.

In some graduating departments, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful training in methods of research. In this way the undergraduate course is linked with the graduate courses, and with the work of the School of Engineering Research (page 23).

As part of the laboratory instruction, excursions to places of technical interest, both in Toronto and elsewhere, are arranged by the staff. These excursions are treated as laboratory periods with the same requirements as to attendance and reports. The total transportation costs in any one year will probably not exceed ten dollars.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The program and regulations regarding the courses of study and examinations, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course, to the conditions here laid down.

Communications relating to curricula, instruction and examinations, in the Faculty of Applied Science and Engineering, should be sent to the Secretary of the Faculty.

DEPARTMENT OF CIVIL ENGINEERING
(DEPT. 1)

The course in Civil Engineering has been so designed as to be broad and comprehensive, with a view to meeting not only the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire a technical training of such a basic character as to enable them to enter various other fields of technical employment. Concurrent with the instruction in engineering subjects, sufficient attention is given to economic, legal and administrative matters to make the graduate in this Department fitted to enter not only upon such work as Municipal Engineering, Sanitary Engineering, Highway Engineering, Railway Engineering, Geodetic Surveying, Structural Engineering and Hydraulic Engineering, but also upon administrative and executive work in both engineering and industrial undertakings.

The subjects of instruction are shown in the tables below. In these tables reference numbers have been assigned to the subjects to assist in distinguishing them; *e.g., Analytical Geometry, 238*, page 95.

FIRST YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus...............	236	2	–	2	–
Applied Physics............	187	1	3	1	3
Business..................	121	–	–	1	–
Descriptive Geometry.......	160	1	–	1	–
Dynamics.................	2	2	–	2	–
Electricity................	135	2	–	2	–
Engineering Drawing........	166	–	10	–	17
General Chemistry..........	84	2	–	1	–
Physical Training...........	280	–	2	–	2
Statics....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus..................	237	2	–	2	–
Chemical Laboratory........	89	–	–	–	6
Descriptive Geometry........	162	1	–	1	–
Economics and Finance......	123	1	–	1	–
Electricity..................	143, 144a	1	3	1	–
Elementary Astronomy......	71	1	–	1	–
Engineering Drawing........	169	–	5	–	10
Engineering Chemistry.......	93	1	–	–	–
Geology....................	195	–	–	2	–
Inorganic Chemistry.........	87a	1	–	–	–
Least Squares..............	240	–	–	1	–
Mechanics of Materials......	4	2	–	2	–
Mineralogy................	257, 259	2	1	–	2
Organic Chemistry..........	95	–	–	1	–
Physical Metallurgy.........	252	–	–	1	–
Physical Training...........	280	–	2	–	2
Public Speaking.............	133	–	–	1	–
Spherical Trigonometry......	239	1	–	–	–
Surveying..................	272, 273	1	9	1	–

THIRD YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Elasticity...........	10a	1	–	1	–
Astronomy and Geodesy.....	72, 73	2	2	2	–
Cements and Concrete.......	11	1	–	1	–
Descriptive Geometry........	164	1	–	–	–
Engineering Chemistry.......	102	1	–	1	–
Engineering Drawing........	173	–	13	–	14
Engineering Geology.........	197	1	–	1	–
Hydraulics.................	205, 206	2	–	2	3

THIRD YEAR SUBJECTS DEPT. 1—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Machinery	229	1	–	1	3
Mechanics of Materials Lab.	9	–	5	–	–
Stress Graphics	10	1	–	1	–
Survey Camp	275	–	–	–	–
Surveying	274	1	–	1	–
Theory of Structures	6	2	–	2	–
Thermodynamics	223, 224	1	–	1	2

FOURTH YEAR SUBJECTS DEPT. 1 (a) GENERAL OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Contracts and Specifications	127	–	–	1	–
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Foundations	14	1	–	1	–
Hydraulics	211	1	3	1	–
Management	128	1	–	–	–
Mechanics of Materials Lab.	13	–	3	–	3
Miscellaneous Structures	19	–	–	1	–
Reinforced Concrete	15	1	–	1	–
Structural Design	17, 18	2	–	1	–
Structural Design Drawing	178	–	15	–	15
Theory of Structures	12	2	–	2	–
Thesis	285	–	3	–	–

And *one* of the following Elective Groups:

(1) Highway Engineering	268	–	–	1	3
(1) Sanitary Engineering	267, 267a	1	–	1	3
(1) Municipal Administration	131	–	–	1	–
(2) Railway Engineering	269	1	–	2	4
(2) Railway Structures	269a	1	–	–	2

FOURTH YEAR SUBJECTS DEPT. 1 (b) ASTRONOMY OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Astronomy	74, 76	2	23	2	–
Contracts and Specifications	127	–	–	1	–
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Geodesy	75, 76	2	–	2	23
Management	128	1	–	–	–
Photographic Surveying	189	1	2	1	2
Survey Camp	275	–	–	–	–
Thesis	285	–	3	–	–

DEPARTMENT OF MINING ENGINEERING

(DEPT. 2)

The course in Mining Engineering, which originated in 1878 as a course in Assaying and Mining Geology, is intended to serve as a preliminary training for those who expect to practise in some branch of Mining Engineering, such as exploration of mining areas and primary development, mine surveying, mining processes involving civil, mechanical and electric work of underground workings, mining machinery and operation; milling and treatment of ores, assaying and other forms of analysis and research, and administrative work in both engineering and industrial undertakings.

A candidate for the degree in the Department of Mining Engineering will be required to present satisfactory evidence of having had at least six months' practical experience in work connected with mining, metallurgy or geology, for which he must have received regular wages.

The time may be spent in geological survey, in ore dressing, smelter, or lixiviation works, in an assay office in the vicinity of mining or metallurgical works, in prospecting, or on any work in or about a mine other than as an office man, or clerk. Prospecting will only count one-half (*e.g.*, four months' prospecting will be counted as two months) and must not be submitted for more than three of the six months. Not more than three months on geological surveys or in assaying will be accepted as part of the six months.

It is important to note that this experience may be put in before the student is admitted to the University.

The subjects of instruction are shown in the tables below. In these tables reference numbers have been assigned to the subjects to assist in distinguishing them; *e.g.*, *Analytical Geometry*, *238*, page 95.

FIRST YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry. and....	238	1	–	2	–
Calculus................	236	2	–	2	–
Business....................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Drawing........	166	–	9	–	12
General Chemistry..........	84	2	–	1	–
Mineralogy..................	255, 258	2	1	–	3
Mining Laboratory..........	50	–	–	–	3
Physical Training...........	280	–	2	–	2
Problems and Seminar.......		–	3	–	3
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	89, 90	–	6	–	6
Descriptive Geometry........	162	1	–	1	–
Dyn. and Struct. Geology....	198	1	–	–	–
Economics and Finance......	123	1	–	1	–
Electricity..................	143	1	–	1	–
Elementary Petrography.....	260	1	–	1	–
Engineering Drawing........	169	–	3	–	10
Geology....................	195	–	–	2	–
Inorganic Chemistry.........	87a	1	–	–	–
Inorganic Chemistry.........	87b	–	–	1	–
Mechanics of Materials......	4	2	–	2	–

SECOND YEAR SUBJECTS DEPT. 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Metallurgy	241	–	–	1	–
Mineralogy	261	–	2	–	2
Mining	51, 53	1	3	–	–
Physical Training	280	–	2	–	2
Problems and Seminar		–	3	–	3
Steam Engines	216	1	–	–	–
Surveying	272a, 273	1	6	1	–
Theory of Measurements	65	1	–	–	–
Vacation Work	68	–	–	–	–

THIRD YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88, 99	1	6	1	3
Assaying	45, 46	1	3	–	3
Economic Geology	202, 203	1	–	3	2
Engineering Chemistry	102	1	–	1	–
Engineering Drawing	174	–	6	–	3
Geological Field Work	193	–	–	–	–
Hydraulics	205, 206	2	–	2	3
Introductory Research	66	–	3	–	–
Metallurgy	243	1	–	1	–
Mining	54	1	–	1	–
Ore Dressing	58, 59	1	–	1	6
Petrography	262, 263	1	2	1	2
Physics of Ore Dressing	64	1	–	1	–
Problems and Seminar		–	3	–	3
Survey Camp	275	–	–	–	–
Theory of Structures	7	1	–	1	–
Vacation Work	69	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	47, 48	–	–	1	3
Electrical Laboratory	144b	–	3	–	–
Engineering Economics	125	–	–	1	–
Geology, Mining	200	–	–	2	–
Geology, Pleistocene and Physiographic	194, 201	1	1	1	–
Geology, Precambrian	199	2	–	–	–
Machine Design	234	1	–	1	3
Mechanics of Materials Lab.	9	–	–	–	3
Metallurgy	247	1	–	1	6
Mine Cost-Finding and Management	56	1	–	1	–
Mining	55	1	–	1	–
Ore Dressing	60, 61	1	6	1	–
Physical Metallurgy	251	2	3	–	–
Problems and Seminar		–	3	–	3
Thermodynamics	223, 224	1	3	1	–
Thesis	67	–	7	–	9
Vacation Work	70	–	–	–	–

DEPARTMENT OF MECHANICAL ENGINEERING
(DEPT. 3)

The mechanical engineer is concerned with the production and the use of power, and it is part of his work to design and manufacture suitable machinery for this purpose, and to instal and operate it. The Diesel engine and the steam turbine are the products of his effort, and he applies these prime movers to automobiles, aeroplanes, locomotives and other purposes. His work also includes the design of water turbines, and their use in hydro-electric systems.

Other branches of his work are the making of designs for air compressors, machine tools, pumps, refrigerating machines and their application to storage warehouses and ice-making, heating and ventilating equipment, materials-handling and conveying plants, and generally all mechanical work. General industrial and administrative problems are also solved.

An effort is being made to help qualified students interested in the design of aeroplanes and high speed trains and cars, without laying undue stress on such work. Courses of lectures are provided and in the final year some laboratory work in the wind tunnel will be available.

The following course of study has been devised to equip men for this service. The subjects of instruction are shown in the tables below. In these tables reference numbers have been assigned to the subjects to assist in distinguishing them; *e.g.*, *Analytical Geometry*, *238*, page 95.

SHOP WORK

All students in Mechanical Engineering are urged to spend at least 1,600 hours in mechanical work in a good shop, before beginning their final year, and certificates covering this work must be handed in on a standard form, to be obtained from the Secretary, to the Head of the Department of Mechanical Engineering.

If, however, a student presents, on an approved form, a declaration satisfactory to the Department that, on account of the prevailing industrial conditions, he has failed after repeated trials to secure any or all of such shop work, he must submit in place of it an illustrated description of machines and processes, according to the form prescribed. Failure to meet the specified requirements within the time set will result in a failure in shop work, which will be dealt with similarly to a failure in any laboratory subject.

Details of the nature of the work required under this heading will be furnished by the Secretary of the Faculty and the reports presented shall become the property of the University.

All or any part of the shop work may be completed before the student enters the University if he so desires, and he is advised to do part of it before entering the Second Year.

FIRST YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or.....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Applied Physics.............	185a	1	3	1	3
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Drawing........	166	–	9	–	15
General Chemistry..........	84	2	–	1	–
Machines and Processes.......	228	1	–	1	–
Physical Training...........	280	–	2	–	2
Properties of Fluids..........	213	1	–	1	–
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus....................	237	2	–	2	–
Chemical Laboratory........	89	–	–	–	6
Descriptive Geometry........	162	1	–	1	–
Dynamics..................	3a	1	–	1	–
Economics and Finance......	123	1	–	1	–
Electricity..................	136, 137	2	3	2	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Drawing........	170	–	14	–	6½
Hydrostatics................	212	–	–	1	–
Inorganic Chemistry.........	87a	1	–	–	–
Mechanics of Materials......	4, 9	2	–	2	3
Metallurgy.................	241	–	–	1	–
Organic Chemistry..........	95	–	–	1	–
Physical Training...........	280	–	2	–	2
Properties of Fluids..........	214	1	–	1	–
Steam Engines..............	216	1	–	1	–
Theory of Mechanism........	230	2	1½	2	1½

THIRD YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Electrical Laboratory	140	–	$4\frac{1}{2}$	–	3
Engineering Chemistry	102	1	–	1	–
Engineering Drawing	177	–	6	–	3
Heat Engines	218	2	–	2	–
Hydraulics	205, 206	2	–	2	3
Machine Design	233	2	9	2	8
Magnetism and Electricity	138	1	–	1	–
Mechanics of Machinery	231	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Theory of Structures	7	1	–	1	–
Thermodynamics	217, 219	2	3	2	3

FOURTH YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Engineering Economics	125	–	–	1	–
Heat Treatment of Iron and Steel	253	1	–	1	–
Hydraulics	207, 208, 209	3	9	3	6
Industrial Management	130	1	–	1	–
Reinforced Concrete	20	1	–	–	–
Machine Design	235	2	6	2	9
Structural Design	17, 18, 180	2	3	–	–
Thermodynamics	220, 221, 222	3	6	3	9
Thesis	285	–	1	–	1

SHOP WORK

Attention is directed to the note on shop work on page 33.

SCHOOL OF ARCHITECTURE
(DEPT. 4)

The course of instruction in the School of Architecture is arranged to lay a broad foundation for the subsequent professional life of its graduates. A very considerable portion of the course is devoted to architectural design, and a student on graduating should have a thorough knowledge of the broad principles of this important subject, a cultivated taste and an appreciation of the allied arts. In addition, a comprehensive course is given in the various subjects connected with building. French history, literature and conversation, and English literature are given in the first three years.

In the new course of five years a student is required to spend twelve months in the offices of recognized architects. This very important practical work is done in the long summer vacations and satisfactory evidence of its completion must be submitted before the granting of a degree. During the period between graduation and the private practice of his profession, a student should divide his time between the architect's office, where his previous training in drawing and building construction will stand him in good stead, and travel abroad, where he will find that the taste he has formed, his understanding of the history of architectural developments and his knowledge of the French language will equip him for an appreciation of the architecture of the countries he visits.

The subjects of instruction are shown in the tables below. In these tables reference numbers have been assigned to the subjects to assist in distinguishing them; *e.g., Analytical Geometry, 238*, page 95.

FIRST YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus................	236	2	–	2	-
Architectural Design.........	31	–	12	–	14
Building Construction.......	37	–	–	1	–
Descriptive Geometry........	161	1	–	1	–
Elements of Arch. Form......	28	1	–	1	–
Engineering Drawing........	167	–	4	–	4
Field Work..................	271a	–	3	–	–
Freehand Drawing..........	35	–	2	–	2
French.....................	44	2	–	2	–
History of Architecture......	25	1	–	1	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Surveying	270a	1	–	–	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Design.........	31a	–	15	–	15
Descriptive Geometry........	163	1	–	1	–
Economics and Finance......	123	1	–	1	–
Engineering Drawing........	171	–	3	–	3
English.....................	122b	1	–	1	–
Freehand Drawing and Water Colour................	35a	–	2	–	2
French.....................	44a	2	–	2	–
History of Architecture......	25a	1	–	1	–
History of Ornament.........	29	1	–	1	–
Mechanics of Materials.......	5	2	–	2	–
Modelling..................	36	–	2	–	2
Photography...............	188	1	3	1	3
Physical Training...........	280	–	2	–	2
Theory of Arch. Planning....	32	1	–	1	–
Vacation Work..............	41	–	–	–	–

THIRD YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Composition....	33	1	–	1	–
Architectural Design.........	31b	1	20	–	20
Commercial Law............	124	1	–	1	–
Freehand Drawing and Water Colour................	35b	–	2	–	2
French.....................	44b	1	–	1	–
Functional Requirements of Buildings..............	26	1	–	1	–
Garden Design..............	27	1	–	–	–
History of Architecture......	25b	1	–	1	–
Light and Sound............	190	1	2	1	2
Modelling..................	36a	–	2	–	2
Public Speaking............	133	1	–	–	–
Structural Design..........	8	1	3	1	3
Vacation Work..............	42	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Acoustics and Illumination Design..................	191	1	1	1	1
Building Materials..........	38	1	–	1	–
Contracts and Specifications ..	127	–	–	1	–
Freehand Drawing from Life..	35c	–	2	–	2
Functional Requirements of Buildings..............	26	1	–	1	–
Garden Design..............	27a	1	–	–	–
History of Fine Art.........	30	1	–	1	–
Modelling..................	36b	–	2	–	2
Sanitary Science...........	39	1	–	1	–
Structural Design..........	16	1	3	1	3
Vacation Work..............	43	–	–	–	–
and either					
Architectural Design, *or*......	31c	1	21	1	21
Architectural Engineering....	31e	1	21	1	21

Fifth Year Subjects Dept. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Acoustics and Illumination Design	191	1	1	1	1
Arch. Aspects of Town Planning	34	–	–	1	–
Architectural Economics	40a	–	–	1	–
Functional Requirements of Buildings	26	1		1	–
Heating and Air Conditioning	40	1	–	1	–
Professional Practice	39a	1	–	1	–
Structural Design	21	1	3	1	3
Water Colour and Life Drawing	35d	2	–	2	–
and either					
Architectural Design, *or*	31d	2	26	2	26
Architectural Engineering	31f	2	28	2	28

DEPARTMENT OF ENGINEERING PHYSICS
(DEPT. 5)

Admission to this course is granted only to students who meet the special requirements set forth on page 16 of this Calendar.

The course is designed to afford a training in Mathematics and Physics beyond that which it is possible to give in the other undergraduate courses in engineering. It is believed that a wider and more thorough acquaintance with the basic sciences will bring to the student a readier appreciation of the nature of the technical problems with which he will later be confronted and a greater facility in the solution of them. A course of the kind offered should consequently be of particular value to those who desire to enter governmental or industrial research laboratories, or who wish to engage in any original work of investigation or development in the field of applied physics.

Throughout the four years of the course an effort is made to maintain the practical point of view in the theoretical instruction. This is effected, in part, by adopting wherever possible the engineering viewpoint in the teaching of mathematical and scientific subjects, and, in part, by the inclusion of certain basic engineering instruction.

The subjects of instruction are shown in the tables below. In these tables of reference numbers have been assigned to the subjects to assist in distinguishing them, e.g., *Algebra and Calculus*, 292, p. 105.

FIRST YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Algebra and Calculus.........	292	$3\frac{1}{2}$	–	$3\frac{1}{2}$	–
Analytical Geometry.........	293	$1\frac{1}{2}$	–	$1\frac{1}{2}$	–
Descriptive Geometry........	160	1	–	1	–
Electricity..................	135	2	–	2	–
Engineering Drawing.........	184	–	3	–	6
Engineering Mechanics	5a	2	–	2	–
General Chemistry...........	85, 86 (part)	2	3	1	3
German.....................	265a	2	–	2	–
Mineralogy..................	255, 258a	2	1	–	–
Physical Training............	280	–	2	–	2
Properties of Matter, Mechanics and Heat......	301	3	$4\frac{1}{2}$	3	$4\frac{1}{2}$

SECOND YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Geometry of Space	296	1	–	1	–
Descriptive Geometry	162	1	–	1	–
Differential Calculus	294	2	–	2	–
Electricity	136, 137(part)	2	3	2	–
Elementary Acoustics	304	1	–	–	–
Elementary Light	303	1	–	1	–
Elementary Machine Design	234a	1	3	1	3
Elementary Magnetism and Electricity	302	2	–	1	–
Engineering Chemistry	93	1	–	–	–
German	265b	1	–	1	–
Integral Calculus and Differential Equations	295	3	–	3	–
Magnetism, Electricity, Light, and Acoustics	305	–	3	–	6
Mechanics of Materials	4, 9	2	–	2	3
Physical Chemistry	98	2	–	2	–
Physical Training	280	–	2	–	2

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Engineering Mechanics	5b	2	–	2	–
Alternating Current	139	1	–	2	–
Differential Equations	297	1	–	1	–
Electrical Laboratory	140	–	6	–	6
Electron Tubes and High Frequency Circuits	308	1	–	1	–
Heat	310	1	–	–	–
Introduction to the Theory of Functions	298	1	–	1	–
Magnetism and Electricity	138	2	–	1	–
Mathematical Operations Applied to Physics	306	1	–	1	–
Mineralogy	260 or 264	1	–	1	–

THIRD YEAR SUBJECTS, DEPT. 5—*Continued.*

Optics	312	1	3	1	3
Organic Chemistry	110a	1	–	1	–
Physical Laboratory	311	–	6	–	3
Physical Metallurgy	244	1	–	1	–
Properties of Matter	309	2	–	2	–
Theory of Potential and Electrical Measurements	307	1	–	1	–
Thermodynamics	225	2	–	2	3

In the Fourth Year the student would be expected to devote approximately thirty hours per week to one of the six groups indicated below:

(1) Electricity and Communications.

The greater part of the time in this option would be devoted to Advanced Mathematics pertaining to Physics, Conduction through Gases, Radioactivity, Atomic Structure, Acoustics, Electromagnetic Theory, Radiotelegraphy, Engineering Economics and a Thesis. The remainder would be devoted either to (a) Applied Electricity or to (b) Spectroscopy and X-rays.

(2) Geophysics.

This would include such courses in Mathematics, Physics, Geology, Mineralogy and Mining as are necessary to equip the student both for investigation and for practical employment in the field of Geophysics.

(3) Applied Hydromechanics.

This would include lectures in Advanced Mathematics and Hydrodynamics, supplemented by laboratory work in the measurement of pressure and stream line velocities; a course of lectures in modern aircraft and the practical application of hydrodynamic theory of of railway and automobile equipment; and a course of lectures with problems on the design of members resisting hydrodynamic flow.

(4) Elasticity of Materials and Structures.

In this option the greater part of the time would be given to the Mathematical Theory of Elasticity, Applied Elasticity and Advanced Structural Analysis, supplemented by practical work on the determination of stresses by the measurement of deformations of models and by photo-elasticity. The remainder would be devoted to either (a) Vibration of Structures or to (b) Vibration of Machines.

(3) Illumination and Acoustics.

The work of this option would be directed to Advanced Mathematics pertaining to Physics, Physics of Light Production, Application of Electron Tubes to the Measurement of Light and Sound, Photometry, Illumination Design, Architectural Acoustics, and Vibration in Buildings.

(6) Heating, Refrigeration and Air Conditioning.

In this option courses of lectures would be given supplemented by experimental work of particular value to investigators in these fields.

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(DEPT. 6)

The course is designed to give the student a thorough training in the underlying principles and laboratory methods of inorganic, organic, physical and analytical chemistry, in the applications of these to industrial chemistry and chemical engineering, and a general knowledge of the elements of thermodynamics, hydraulics, machine design, structural design, electricity, and metallurgy. A preliminary training of this nature with subsequent practical experience will enable him to undertake the design and construction and also the operation and management of the plant required in such branches of chemical industry as are concerned with the production of chemical and pharmaceutical products, petroleum and its products, rubber goods, leather and glue, soap, meat products, foodstuffs, vegetable and animal oils, sugar, pulp and paper, vegetable and animal fibres, artificial silk, coal tar and wood distillates, paints and varnishes, explosives, dyes, portland cement, metals and their alloys, electrochemical products, fermentation products, fertilizers, etc.

For those who by temperament and ability are attracted to chemical research there exist excellent opportunities in government, industrial, and medical research laboratories. Properly qualified students wishing to pursue experimental investigation as a life-work whether in industrial chemistry or in purely scientific chemistry may proceed in this department to the degrees M.A.Sc. and Ph.D., the laboratory research work of the Fourth Year serving as a connecting link between the undergraduate and graduate courses.

The subjects of instruction are shown in the tables below. In these tables reference numbers have been assigned to the subjects to assist in distinguishing them; *e.g.*, *Analytical Geometry*, *238*, page 95.

FIRST YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Biological Laboratory........	80	–	–	–	3
Business....................	121	–	–	1	–
Chemical Laboratory........	86	–	13	–	12
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Drawing........	168	–	2	–	3
General Chemistry..........	85	2	–	1	–
German....................	265	2	–	2	–
Mineralogy Laboratory......	256	–	2	–	1
Optics	185b	1	3	1	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus..................	237	2	–	2	–
Applied Physics Laboratory ..	186	–	–	–	1
Chemical Laboratory........	92, 97	–	10	–	8
Economics and Finance......	123	1	–	1	–
Electricity..................	136, 137	2	3	2	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Drawing........	172	–	7	–	3
German....................	265	1	–	1	–
Hydrostatics................	212	–	–	1	–
Industrial Chemistry.........	94	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Industrial Chemistry	94a	–	–	–	5
Inorganic Chemistry	87a	1	–	–	–
Inorganic Chemistry	87b	–	–	1	–
Mechanics of Materials	4	2	–	2	–
Metallurgy	241	–	–	1	–
Organic Chemistry	96	2	–	2	–
Physical Chemistry	98	2	–	2	–
Physical Training	280	–	2	–	2

THIRD YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88	1	–	1	–
Assaying Laboratory	49	–	3	–	–
Chemical Laboratory	100, 106	–	13	–	13
Chemical Plant	104	1	–	1	–
Electrical Laboratory	144c	–	–	–	3
Electricity	143	1	–	1	–
Electrochemistry	107, 108	2	3	–	–
Engineering Chemistry	102	1	–	1	–
Engineering Drawing	177	–	3	–	3
German	265	1	–	1	–
Hydraulics	205, 206	2	–	2	1½
Industrial Chemistry	103	1	–	1	–
Metallurgy	243	1	–	1	–
Organic Chemistry	105	2	–	2	–
Physical Metallurgy	244	–	–	2	–
Theory of Structures	7	1	–	1	–
Thermodynamics	217, 224	2	–	2	1½

FOURTH YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
German, *or*	265	1	–	1	–
Spanish	266	1	–	1	–
Industrial Management	130	1	–	1	–
Inorganic Chemistry	109	2	–	2	–
Machine Design	234	1	–	1	3
Organic Chemistry	110, 111	1	17	1	–
Thesis	285	–	–	–	–
and *one* of					
1. Electrochemistry	114, 115	2	*	2	*
2. Industrial Chemistry	112, 113	1	*	1	*
3. Metallurgy and	247	1	*	1	*
Ore Dressing and	62, 63, 64	2	–	2	6
Physical Metallurgy	250	1	*	1	*
4. Sanitary and Forensic Chem. and Bacteriology	116	1	*	1	*
5. Zymology	283	*	*	*	*

*All time not otherwise allotted must be spent in the various laboratories in the proportions assigned by the Department.

For information regarding the courses of study leading to the degrees, Master of Applied Science and Doctor of Philosophy, see pp. 147 and 149 of this calendar, also the calendar of the School of Graduate Studies, which gives full particulars.

DEPARTMENT OF ELECTRICAL ENGINEERING
(DEPT. 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields beside that of his specialty, electrical technique. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but thermodynamics, hydraulics, theory of mechanisms, machine design, business, economics and finance, commercial law, and other non-electrical subjects.

In the electrical field much time is given to calculation of circuits of electric, magnetic and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years. Certain options in this Year are available in combination with general electrical engineering; viz., hydraulics, thermodynamics, radio-telegraphy and acoustics, electro-chemistry and illumination.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial or administrative responsibilities.

The subjects of instruction are shown in the tables below. In these tables reference numbers have been assigned to the subjects to assist in distinguishing them; *e.g.*, *Analytical Geometry*, *238*, page 95.

FIRST YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus..............	236	2	–	2	–
Applied Physics............	185a	1	3	1	3
Business.................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics.................	2	2	–	2	–
Electricity................	135	2	–	2	–
Engineering Drawing........	166	–	12	–	17
General Chemistry..........	84	2	–	1	–
Physical Training...........	280	–	2	–	2
Practical Experience.........	276	–	–	–	–
Statics....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English..........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus...................	237	2	–	2	–
Chemical Laboratory........	89	–	6	–	–
Descriptive Geometry........	162	1	–	1	–
Dynamics.................	3	2	–	2	–
Economics and Finance......	123	1	–	1	–
Electricity................	136, 137	2	3	2	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Drawing........	170	–	9½	–	14½
Hydrostatics...............	212	–	–	1	–
Inorganic Chemistry.........	87a	1	–	–	–
Mechanics of Materials.......	4	2	–	2	–
Organic Chemistry..........	95	–	–	1	–
Physical Training...........	280	–	2	–	2
Practical Experience.........	276	–	–	–	–
Steam Engines..............	216	1	–	1	–
Theory of Mechanism.......	230	2	1½	2	1½

THIRD YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current.........	139	1	–	2	–
Commercial Law............	124	1	–	1	–
Electrical Design............	141, 142	1	3	1	3
Electrical Laboratory........	140	–	6	–	6
Electrochemistry............	107, 108	2	3	–	–
Engineering Chemistry.......	102	1	–	1	–
Heat Engines...............	218	1	–	1	–
Hydraulics.................	205, 206	2	–	2	3
Machine Design.............	233	2	3	2	6
Magnetism and Electricity....	138	2	–	1	–
Mechanics of Machinery.....	231	1	–	1	–
Physical Metallurgy.........	244	–	–	2	–
Practical Experience.........	276	–	–	–	–
Thermodynamics............	217, 219	2	3	2	–

FOURTH YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Electricity..........	145, 146	5	20	5	19
Engineering Economics.......	125	–	–	1	–
Industrial Management......	130	1	–	1	–
Practical Experience.........	276	–	–	–	–
Thesis.....................	285	–	–	–	–
and *one* of					
1. Radiotelegraphy.........	147, 148, 149	3	9	2	9
2. Electrochemistry.........	114, 115	2	9	2	9
3. Hydraulics..............	207, 208, 209	3	9	3	6
4. Illumination	192, 192a	2	9	2	9
5. Thermodynamics.........	220, 221, 222	3	9	3	6

DEPARTMENT OF METALLURGICAL ENGINEERING
(DEPT. 8)

This course is designed for those who intend to take up work in the production, treatment and working of metals for the purposes of industry; or the design, construction, or operation of metallurgical plants including smelters, furnaces, foundries, refineries, and lixiviation works; and administrative work in both engineering and industrial undertakings.

An optional course in this Department is provided in the Third and Fourth Years for those students who wish to become Ceramic Engineers. Ceramic plant experience, approved by the Department, will be necessary before the student will be given his degree. The Ceramic field includes the non-metallic mineral industry and the course given embraces the fundamentals of the manufacture of heavy clay products, porcelain, whiteware, earthenware, refractories, terra cotta, glass, enamelled iron, abrasives, gypsum products, cements, etc., as well as the raw materials used in these industries.

The subjects of instruction are shown in the tables below. In these tables reference numbers have been assigned to the subjects to assist in distinguishing them; *e.g.*, *Analytical Geometry*, *238*, page 95.

FIRST YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus................	236	2	–	2	–
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics.................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Engineering Drawing........	166	–	11	–	18
General Chemistry..........	85	2	–	1	–
Mineralogy................	255, 258a	2	1	–	–
Physical Training...........	280	–	2	–	2
Statics....................	1	2	–	2	–
Surveying.................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	87a, 87b, 91	1	14	1	13
Economics and Finance	123	1	–	1	–
Electricity	136, 137	2	3	2	3
Engineering Drawing	172	–	3	–	6
Geology and Ore Deposits	196	1	1	1	1
Mechanics of Materials	4	2	–	2	–
Metallurgy	241, 242	1	–	2	–
Mining	51, 52	1	–	1	–
Physical Training	280	–	2	–	2
Steam Engines	216	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88	1	–	1	–
Assaying	45, 46	1	3	–	3
Cements and Concrete	11	1	–	–	–
Chemical Laboratory	101	–	–	–	6
Electricity	143,144e	1	3	1	3
Electrochemistry	107, 108	2	3	–	–
Engineering Drawing	182	–	3	–	–
Engineering Chemistry	102	1	–	1	–
Heat Engines	218	1	–	1	–
Metallurgy	245	2	3	1	6
Ore Dressing	58, 59	1	3	1	3
Physical Metallurgy	246	1	3	1	–
Physics of Ore Dressing	64	1	–	1	–
Thermodynamics	223, 224	1	–	1	3

THIRD YEAR SUBJECTS DEPT. 8 (a) CERAMIC OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Cements and Concrete.......	11	1	–	–	–
Ceramic Calculations........	254c	–	–	1	–
Ceramic Laboratory.........	254e	–	6	–	6
Ceramics, General and Mfg...	254a	4	–	2	–
Clay Testing................	254d	–	9	–	3
Electricity..................	143, 144f	1	–	1	3
Elementary Petrography.....	260	1	–	1	–
Engineering Chemistry.......	102	1	–	1	–
Engineering Drawing........	177	–	6	–	5
Engineering Geology.........	197	1	–	1	–
Glazes.....................	254b	–	–	2	–
Heat Engines...............	218	1	–	1	–
Physical Chemistry..........	98	2	–	2	–
Theory of Structures.........	7	1	–	1	–
Thermodynamics............	223, 224	1	–	1	3

FOURTH YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying..................	47, 48	–	–	1	3
Contracts and Specifications..	127	–	–	1	–
Electrochemistry............	114, 115	2	–	2	6
Engineering Economics.......	125	–	–	1	–
Hydraulic Laboratory........	210	–	–	–	3
Machine Design.............	234	1	–	1	3
Metallurgy.................	249	1	–	1	–
Metallurgy Problems........	248	2	4	2	4
Ore Dressing...............	60, 61	1	6	1	–
Physical Metallurgy.........	250	1	3	1	3
Plant Management..........	129	–	–	1	–
Thesis.....................	285	–	6	–	6

FOURTH YEAR SUBJECTS DEPT. 8 (a) CERAMIC OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Ceramic Laboratory	254i	–	7	–	9
Ceramic Products and Spec'ns	254h	–	–	1	–
Commercial Law	124	1	–	1	–
Contracts and Specifications	127	–	–	1	–
Glass and Enameled Iron	254g	–	–	2	–
Machine Design	234	1	–	1	3
Petrography	262, 263	1	2	1	2
Plant Management	129	–	–	1	–
Pleistocene Geology	194, 201	1	3	1	–
Refractories and Ceramic Bodies	254f	2	–	–	–
Silicate Chemistry	116a	2	–	–	–
Structural Design	18	1	–	–	–
Structural Design Drawing	183	–	6	–	6
Thesis	285	–	9	–	8

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 1. Applied Mechanics—Statics, means the course of lectures indicated by this number in the table of curriculum for the First Year on page 25.

MECHANICS AND DESIGN OF STRUCTURES

1. Applied Mechanics—Statics. T. R. Loudon.

All departments I Year; 2 hrs. per week, both terms.

This course of lectures deals with the fundamental principles of the laws of equilibrium of forces. These principles are applied to the determination of stresses in simple structures. Toward the end of the course an introduction to Mechanics of Materials is given.

Text: Analytical Mechanics for Engineers—Seely and Ensign.

2. Applied Mechanics—Dynamics. M. J. C. Lazier.

Departments 1, 2, 3, 6, 7, 8, I Year; 2 hrs. per week, both terms.

This course of lectures is designed to extend the elementary principles of preparatory school mechanics to a more general viewpoint. Under the heading of Kinematics, the general equations of motion, both linear and angular, are developed.

Centres of mass and moments of inertia are calculated.

The principles of linear and angular momentum are dealt with and a fairly comprehensive course on effective and inertia forces as applied to engineering problems is given. The discussion of energy, work and power is extended as far as possible to practical problems.

Simple Harmonic Motion is also discussed.

Text: Tutorial Dynamics—Briggs and Bryan. Analytical Mechanics for Engineers—Seely and Ensign.

3. Dynamics. B. A. Griffith.

Department 7, II Year; 2 hrs. per week, both terms.

The lectures deal with centres of mass, moments of inertia, kinematics, simple harmonic motion, linear and angular momentum, rotating and rolling bodies, friction, impulsive motion.

Text: An Introduction to Mechanics—J. W. Campbell.

3(a). Applied Mechanics—Dynamics. T. R. Loudon, M. J. C. Lazier.

Department 3, II Year; 1 hr. per week, both terms.

This course of lectures extends the work of the First Year to more general applications, such as: bodies moving with general plane

motion, compound pendulum, gyroscopic action. A short discussion of the fundamental theory of hydrodynamics with particular reference to determining stream line flow is included in these lectures.

Texts: Analytical Mechanics for Engineers—Seely and Ensign. Hydromechanics, Part II—Ramsey.

4. Applied Mechanics—Mechanics of Materials. T. R. Loudon.

Departments 1, 2, 3, 5, 6, 7, 8, II Year; 2 hrs. per week, both terms.

In this course, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Reference book: Strength of Materials—Case.

5. Applied Mechanics—Mechanics of Materials. T. R. Loudon.

Department 4, II Year; 2 hrs. per week, both terms.

This course deals with the mathemactical consideration of stress and elasticity. Among the problems taken up are the consideration of riveted joints, theory of simple and continuous beams, the theory of columns and simple column footings.

Text: Strength of Materials—Boyd.

5*a*. Applied Mechanics—Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Depatrment 5, I Year; 2 hrs. per week, both terms.

This course of lectures deals with the determination of stresses in simple framed structures and beams. The course also includes an elaboration of the kinematics and kinetics of masses having particular reference to simple mechanical parts.

Test books: Analytical Mechanics for Engineers—Seely and Ensign.

5*b*. Applied Mechanics—Advanced Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Department 5, III Year; 2 hrs. per week, both terms.

This course of lectures deals with advanced theory of harmonic motions as applied to stress analysis in engineering problems. The theories of elasticity are also elaborated in this course and applied to various types of structural examples.

6. Theory of Structures. C. R. Young, C. F. Morrison.

Department 1, III Year; 2 hrs. per week, both terms.

The work of the first term comprises a discussion of timber beams, and details, combined stresses, columns, trussed beams, box girders, and plate girders. A number of designs of structures and structural details are worked out in the class and drafting rooms.

The second term is given chiefly to moving loads, the design of a riveted truss highway span and the theory of railway truss spans. Problems relating to the design of typical structures of these types are worked out in the lecture and drafting rooms.

Text: Modern Framed Structures, Part III—Johnson, Bryan and Turneaure. Structural Members and Connections—Hool and Kinne. Elementary Structural Problems—Young. A.I.S.C. Handbook, Steel Construction. Structural Design in Steel—Shedd.

7. Theory of Structures. C. F. Morrison.

Departments 2, 3, 6 and 8a, III Year; 1 hr. per week, both terms.

The work is practically the same as that for course 6 in the first term.

8. Structural Design. C. F. Morrison.

Department 4, III Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

The stress analysis of simple structures is discussed in this course. Practical problems on the design of beams, columns, piers, footings, and roof trusses are worked out in the drafting room. An introduction to reinforced concrete is also given.

Reference Book: Architectural Construction—Gay and Parker.

9. Mechanics of Materirls. C. R. Young, W. L. Sagar.

Departments 3 and 5, II Year, Department 2, IV Year, 3 hrs. per week, one term; Department 1, III Year, 5 hrs. per week, one term.

This laboratory course is intended to give the student an introduction to the experimental study of the strength and elasticity of materials. It is intended that he shall acquire some familiarity with the construction and operation of testing machines and with the properties of ordinary materials of construction.

Reference: Junior Laboratory Course in Mechanics of Materials, Department of Civil Engineering; Municipal and Structural.

10. Stress Graphics. C. F. Morrison.

Department 1, III Year; one hr. per week, both terms.

This course of lectures deals with graphic methods of determining stresses in framed structures, the construction of shearing force diagrams, bending moment diagrams and influence lines. Some attention is also given to the principles of formula charting.

Text book: Graphic Analysis—Wolfe.

10*a*. Applied Elasticity. T. R. Loudon.

Department 1, III Year; one hr. per week, both terms.

In this course of lectures, the fundamental principles of elasticity are extended to apply to the determination of deformations and stresses in several of the well known types of structures and structural members where ordinary statical methods fail to give a solution of the problem.

Texts: Applied Elasticity—Timoshenko and Lessels. A Treatise on the Mathematical Theory of Elasticity—Love.

11. Cements and Concrete. C. F. Morrison, W. L. Sagar.

Department 1, III Year; 1 hr. per week, both terms.

Departments 8 and 8a, III Year; 1 hr. per week, first term.

The manufacture, testing and use of Portland cement and the fundamentals of the theory of reinforced concrete are discussed in this course of lectures.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete Construction, Vol. I—Hool.

12. Theory of Structures. C. R. Young.

Department 1a, IV Year; 2 hrs. per week, both terms.

The work comprised in this course of lectures concerns arches, suspension bridges, cantilever bridges, movable bridges, deflections, statically indeterminate systems, and secondary stresses. Problems based on the lectures are worked out in the drafting rooms.

Reference books: Modern Framed Structures, Part II—Johnson, Bryan and Turneaure.

13. Mechanics of Materials. C. R. Young, W. L. Sagar.

Department 1a, IV Year; a laboratory course of 3 hrs. per week, both terms.

This course of experiments is intended to give the student practice in investigating the elastic and physical properties of iron, steel, concrete, timber, etc., and in the use of instruments of precision designed for that purpose.

Reference book: Materials of Construction—Johnson.

14. Foundations, Retaining Walls and Dams. T. R. Loudon, W. J. Smither.

Department 1a, IV Year; 1 hr. per week, both terms.

This course of lectures is devoted to the design of the structures mentioned. The most approved forms of construction of retaining walls, footings, abutments, piers and dams are described, and typical designs are worked out in the class and drafting rooms.

Text books and books of reference: Retaining Walls for Earth—M. A. Howe. Walls, Bins and Grain Elevators—M. S. Ketchum. Design and Construction of Dams—E. Wegmann.

15. Reinforced Concrete. C. R. Young.

Department 1a, IV Year; 1 hr. per week, both terms.

The theory of the strength of reinforced concrete elements including the beam, the slab, the T-beam, the column and the girderless floor, is continued in this course.

The analysis of the monolithic arch by the elastic theory is

discussed, and the student is required in the drafting room to apply his knowledge to the design of simple structures.

Reference books: Principles of Reinforced Concrete Construction—Turneaure and Maurer. Reinforced Concrete Design—Sutherland and Clifford.

16. Structural Design. C. F. Morrison.

Department 4, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

In this course the properties of the materials used and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of columns, beams, and slabs are made. The lectures are supplemented by the working of problems in the drafting room.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Architectural Construction—Gay and Parker.

17. Structural Design. C. R. Young, W. J. Smither.

Department 1a, IV Year; 1 hr. per week, both terms.

Department 3, IV Year; 1 hr. per week, first term.

In this course of lectures consideration is given to such matters as mill construction buildings, timber framing, economic arrangement of building frames, probable loadings for girders and columns, column eccentricities, crane runways, cableways, wind bracing, and rigid frames.

Text books: Handbook of Building Construction—Hool and Johnson. Architects' and Builders' Handbook—Kidder-Parker.

18. Structural Design. C. R. Young, W. J. Smither.

Departments 1a, 3 and 8a, IV Year; 1 hr. per week, first term.

Consideration is given in this course to the various types of mill buildings, to the conditions governing their choice and to the design and details of construction in different materials. Designs of portions of mill buildings are worked out in the class and drafting rooms.

Text books: Steel Mill Buildings—Ketchum. Mill Buildings—Tyrrell.

19. Miscellaneous Structures. W. J. Smither.

Department 1a, IV Year; 1 hr. per week, second term.

In this course of lectures the application of theoretical principles to the design of a variety of structures is made. Among those structures discussed are transmission line towers, elevated tanks and their supporting towers, standpipes, large pressure pipes, sewers, culverts, small highway bridges, sub-surface tanks and tall chimneys. Whenever possible the lecture work is followed up by designs in the drafting room.

20. Reinforced Concrete. C. F. Morrison.

Department 3, IV Year; 1 hr. per week, first term.

In this course the properties of the materials involved and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of columns, beams, floors and footings are made.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete Construction, Vol. I—Hool.

21. Structural Design. T. R. Loudon.

Department 4, V Year; 1 hr. lect. and 3 hrs. lab. per week, both terms.

In this course the students apply the principles of structural design to problems in which actual buildings are designed and detailed.

ARCHITECTURE, DRAWING AND PAINTING

25. History of Architecture. E. R. Arthur.

Department 4, I Year; 1 hr. per week; both terms.

In this course the development of architecture is traced from prehistoric times to the Romanesque.

24*a*. History of Architecture. H. J. Burden.

Department 4, II Year; 1 hr. per week; both terms.

In this course the development of architecture is traced from the Romanesque Period to the present time.

25*b*. History of Architecture.

Department 4, III Year; 1 hr. per week, both terms.

Part 1 Miss J. C. Laing.

Brief course of lectures on the History of Italy from the Fall of Rome to the close of the Renaissance, as a background to the architecture of the period.

Part 2 H. H. Madill.

In this course the work of the Renaissance in Italy and France is taken in detail.

Part 3. E. R. Arthur.

This course of lectures covers the period 1500-1800 in England, with two or three lectures dealing with the 19th Century. Lectures on furniture will be given in this course with special reference to the development of furniture in England from Mediaeval times.

26. Functional Requirements of Buildings. H. H. Madill, E. R. Arthur, A. S. Mathers.

Department 4, III, IV and V Years; 1 hr. per week, both terms.

In this course of lectures the principles underlying the planning of such large buildings as churches, departmental stores, theatres, schools, railway stations, etc., are discussed in detail.

27. Garden Design. H. B. Dunnington Grubb.

Department 4, III Year. Special lectures, first term.

In this course the historical development of Garden Design is traced from earliest times; the study of sites; the influence of topography, orientation, access, etc., on the problems of design; site planning; the location of buildings; the solution of an actual problem on a typical site.

27*a*. Garden Design. H. B. Dunnington Grubb.

Department 4, IV Year. Special lectures, first term.

The work of the previous year is continued and a problem is set in the studio involving principles of both architectural and garden design.

28. Elements of Architectural Form. E. R. Arthur.

Department 4, I Year; 1 hr. per week, both terms.

The elements of architectural form consist of the study of doors, windows, columns, wall treatment, roofs, mantels, chimney stacks, etc. These are examined without regard to particular style and from the standpoint of design rather than construction.

29. Architectural Ornament. H. J. Burden.

Department 4, II Year; 1 hr. per week, both terms.

In this course the development of ornament is considered, with the corresponding history.

30. History of Fine Art. C. W. Jefferys.

Department 4, IV Year; 1 hr. per week, both terms.

The course consists of an outline of the history and development of painting and of the minor pictorial arts from the earliest time until the present day, followed by an outline of the history and development of the different eras of sculpture ranging from the primitive to the present day.

31. Architectural Design. H. H. Madill, E. R. Arthur, W. E. Carswell.

Department 4, I Year. 12 hrs. per week, both terms.

This comprises work done in the studio, including lettering, drawing, and rendering such elementary studies as a door, a window, etc., and exercises in simple composition.

An elementary design is carried to the stage of working drawings. Furniture, mantels, etc., in the Royal Ontario Museum are drawn to scale.

31*a*. Architectural Design. E. R. Arthur, Mackenzie Waters.

Department 4, II Year. 15 hrs. per week, both terms.

This course is given by means of individual instruction in the studio, and by criticisms of the solutions of different problems set during the year. It is in this course that the student begins the serious study of design; continued practice in architectural drawing

and rendering affords the training necessary to make of the student a proficient draughtsman.

One of the students' designs of a building is carried through to the stage of working drawings, which may include full-size details.

31*b*. Architectural Design. E. R. Arthur, Mackenzie Waters.

Department 4, III Year. 20 hrs. per week, both terms.

This course is given by individual instruction in the studio and by criticisms of solutions of problems set during the year. The greater part of the course is devoted to problems in design and forms a continuation of the course given in the preceding year.

One of the students' designs of a building is carried through to the stage of working drawings, which may include full-size details.

31*c*. Architectural Design. E. R. Arthur, Mackenzie Waters.

Department 4, IV Year. 20 hrs. per week, both terms.

This course is a continuation of the work of the preceding years, being given by individual instruction in the studio and criticisms of the solution of problems set during the year.

During the second term architectural working drawings of a building designed by the student are prepared in the studio.

One of the students' designs of a building is carried through to the stage of working drawings, which may include full-size details.

31*d*. Architectural Design. E. R. Arthur, Mackenzie Waters.

Department 4, V Year. 26 hrs. per week, both terms.

The course of the preceding year is continued in more advanced problems.

One of the students' designs of a building is carried through to the stage of working drawings, which may include full-size details.

31*e*. Architectural Engineering. H. H. Madill, T. R. Loudon.

Department 4, IV Year; Architectural Engineering Option.

In this course lectures on structural design and layout are given and problems are worked out in the studio. The work is coordinated with problems set in architectural design.

31*f*. Architectural Engineering. H. H. Madill, T. R. Loudon.

Department 4, V Year; Architectural Engineering Option.

In this course the design and preparation of working drawings and structural details of work of a monumental character are carried on in the studio. The student is also required to take such lectures as are prescribed from time to time. The work is coordinated with problems set in architectural design.

32. Theory of Architectural Planning. E. R. Arthur.

Department 4, II Year.

In this course special attention is given to the elements and general principles of architectural planning.

33. Architectural Composition. E. R. Arthur.

Department 4, III Year.

This course consists of a series of lectures on the theory of architectural design, the analysis of composition, proportion, scale, etc.

34. Architectural Aspects of Town Planning. E. R. Arthur.

Department 4, V Year; 1 hr. per week, second term.

In this course of lectures the historical development of town planning is traced with particular reference to the Axial Planning of the Renaissance, public squares, the grouping of buildings and the placing of monuments.

35. Freehand Drawing and Water Colour Painting. H. J. Burden, W. E. Carswell.

Department 4, I Year; 3 hrs. per week, both terms.

Drawing from still life, primary free hand perspective, primary pencil, charcoal, and pen and ink rendering.

35*a*. Freehand Drawing and Water Colour Painting. H. J. Burden, W. E. Carswell.

Department 4, II Year; 3 hrs. per week, both terms.

Drawing and monochrome painting from still life, drawing from the cast, pencil, pen and ink, and monochrome rendering, primary water colour, drawing from landscape and natural objects.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*b*. Freehand Drawing and Water Colour Painting. H. J. Burden, W. E. Carswell.

Department 4, III Year; 3 hrs. per week, both terms.

Drawing from the cast, water colour from still life, water colour rendering, drawing from landscape and natural objects.

Students who are sufficiently advanced are admitted to the Fourth Year Life Drawing Class.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*c*. Freehand Drawing and Water Colour Painting. H. J. Burden, W. E. Carswell.

Departent 4, IV Year; 3 hrs. per week, both terms.

Water colour from still life and from landscape, drawing from life, water colour rendering.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*d*. Water Colour and Life Drawing. C. W. Jefferys.
Department 4, V Year; 2 hrs. per week, both terms.
Advanced water colour drawings and drawings from life.

36. Modelling. Frederick Coates.
Department 4, II Year; 2 hrs. per week, both terms.
Scale models of architectural forms.

36a. Modelling. Frederick Coates.
Department 4, III Year; 2 hrs. per week, both terms.
Scale models of simple buildings.

36*b*. Modelling. Frederick Coates.
Department 4, IV Year; 2 hrs. per week, both terms.
Scale models of buildings and settings.

37. Building Construction. H. H. Madill.
Department 4, I Year; 1 hr. per week, second term.
Instruction is given in elementary construction using common building materials. The detailing of doors, windows, roofs, etc.

38. Building Materials. H. H. Madill.
Department 4, IV Year; 2 hrs. per week, both terms.
The use and structural value of the various building materials is studied.

39. Sanitary Science. H. H. Madill.
Department 4, IV Year; 1 hr. per week; both terms.
Modern plumbing, its design and installation, drainage, sewerage disposal and water supply.

39*a*. Professional Practice. H. H. Madill.
Department 4, V Year; 1 hr. per week, both terms.
This course of lectures is designed to give an understanding of the professional character of the practice of architecture. In it are discussed the ethical, business and legal relations of the architect to clients, contractors, craftsmen, engineers and the professional bodies. The methods of office practice are also discussed.

40. Heating and Air Conditioning. A. Wardell.
Department 4, V Year; 1 hr. per week, both terms.
In this course of lectures the different systems of heating, ventilating and air conditioning of buildings are discussed.

40*a*. Architectural Economics. W. S. Wilson.
Department 4, V Year; 1 hr. per week, second term.
A course of instruction in the various methods of preparing estimates, together with practical work in taking off quantities.

41. Vacation Work. H. H. Madill.
Department 4, II Year.
Each student will be required to submit a set of twenty pages of notes on building construction on or before the opening day of the

session. These notes are to consist of freehand pencil drawings with figured dimensions. Instruction as to the nature of these notes will be given by Prof. Madill before the close of the previous session.

42. Vacation Work. E. R. Arthur.

Department 4, III Year.

Each student is required to submit on or before the opening day of the session a set of rendered measured drawings of existing buildings, or portions of buildings, the building first to be approved by Prof. Arthur, who will also decide the number and size of the drawings to be made. The record of measurements must be preserved in a notebook which will be submitted with the final drawings.

43. Vacation Work. H. J. Burden, W. E. Carswell.

Department 4, IV Year.

Each student is required to submit on or before the opening day of the session a set of at least six outdoor sketches in water colour, pen and ink, or pencil. The minimum size for each sheet will be 9″× 12″. Of these sketches at least two will be in water colour and three will be of an architectural character.

44. French. Miss J. C. Laing.

Department 4, I Year; 2 hrs. per week, both terms.

History of France from Julius Cæsar to Louis XI, with special reference to development of French civilization and culture; brief study of the geography of France; reading of simple texts illustrative of French life, art and literature; practice in conversation.

44*a*. French. Miss J. C. Laing.

Department 4, II Year; 2 hrs. per week, both terms.

History of France from sixteenth century to the eighteenth, with special reference to development of literature and the arts of the classical age; reading from representative authors; continuation from the First Year of study of geography of France, with translation of French texts illustrative of life in Paris and in the provinces.

44*b*. French. Miss J. C. Laing.

Department 4, III Year; 1 hr. per week, both terms.

History of France from the Revolution.

Lectures and reading of French texts, bearing particularly on the History of Renaissance Art.

ASSAYING, MINING AND ORE DRESSING

The work in Mining is directed more to the development of the proper attitude of mind towards mining problems than to the teaching of actual mining methods.

The teaching of Assaying has a two-fold function. The first is to give the student a working knowledge of the practice of the art, so that he can earn money as an assayer on graduation and use this as a stepping-stone to other positions. The second is to use the assaying laboratories for the training of students in certain important phases of engineering methods. The size of the apparatus, the completeness of the processes in short intervals of time, the extreme accuracy of results when so desired, the relation of the extent of error to time and method, the similarity of the academic laboratory to the field laboratory—all these permit an unrivalled opportunity for driving home much broad engineering philosophy. The assaying processes and apparatus lend themselves peculiarly well to the development of a proper perspective in regard to errors and accuracy in measurements.

The study of Ore Dressing, when accompanied by laboratory work in a well-equipped ore dressing laboratory, is one of the most important of the Mining Engineering subjects. Not only is the mechanical treatment of ores a very important branch of Mining Engineering, but the mental processes involved in a study of the fundamental principles underlying the art, and the compromise necessary for field practice form one of the best fields for the development of engineering philosophy. From these points of view, the ore dressing laboratory is exceptionally well equipped.

45. Assaying. J. T. King.

Departments 2 and 8, III Year; 1 hr. per week, first term.

A first course of lectures on the theory of fire assaying. Emphasis is laid not only on the chemical and metallurgical principles involved, but upon the errors inherent in operators as well as in methods.

Text Book: Manual of Fire Assaying—Fulton and Sharwood.

46. Assaying. J. T. King.

Departments 2 and 8, III Year; 3 hrs. per week, both terms.

A laboratory course in the determination of the precious metals in ores, milling and metallurgical products. Scorification and crucible assays of ores and products, pure and impure, fluxes, slags and solutions. Buckboard practice, ores with metallics. Copper and lead by electrolysis. Students are expected to do their later assays with despatch and a reasonable degree of accuracy. Neatness of work is required.

47. Assaying. J. T. King.

Departments 2 and 8, IV Year; 1 hr. lecture per week, second term.

A continuation of course 45. Complex ores. Combination assays. The sampling and assay of bullion. The platinum group metals. Checks and corrections.

48. Assaying. J. T. King.
Departments 2 and 8, IV Year; 3 hrs. per week, second term.
An advanced laboratory course in which some of the methods of course 47 are used.

49. Assaying. J. T. King.
Department 6, III Year; 3 hrs. per week, first term.
An introductory laboratory course for chemical engineers. Some lecture instruction is given. An abbreviation of courses 45 and 46.

50. Mining. H. E. T. Haultain, F. C. Dyer.
Department 2, I Year; 3 hrs. per week, second term.
A laboratory course, including some lectures, being an introduction to certain mining and milling machinery and methods.

51. Mining. H. E. T. Haultain.
Departments 2 and 8, II Year; 1 hr. per week, first term.
An introductory course of lectures.

52. Mining. H. E. T. Haultain.
Department 8, II Year; 1 hr. per week, second term.
An extension of course 51.

53. Mining. F. C. Dyer.
Department 2, II Year; 3 hrs. per week, first term.
A continuation of course 50. Rock drills, sampling methods, use of explosives.

54. Mining. H. E. T. Haultain, F. C. Dyer.
Department 2, III Year; 1 hr. per week, both terms.
Principles of mining.

55. Mining. H. E. T. Haultain.
Department 2, IV Year; 1 hr. per week, both terms.
Special problems, estimates, reports.

56. Mine Cost Finding and Management. H. E. T. Haultain.
Department 2, IV Year; 1 hr. per week, both terms.
One of the fundamental features that must not be lost sight of by the mining engineer is, that his work is designed primarily for purposes of financial profit. This course of lectures deals with details from this point of view. The total cost of a ton of ore requiring as it does an understanding of the problems of amortization, is first dealt with in a broad way. Then are considered various problems of cost finding, leading on to problems of time and motion study which are essential to the development of the fine points of the art in any particular mining problem. The latter part of the course deals with problems of management, the relation of members of the staff to each other, and the relations of the staff to labour.

58. Ore Dressing. H. E. T. Haultain, F. C. Dyer.

Departments 2 and 8, III Year; 1 hr. per week, both terms.

The general principles of Ore Dressing.

59. Ore Dressing. F. C. Dyer,

Departments 2 and 8, III Year; 6 continuous hrs. per week, second term.

Work with crushing machinery, principles of crushing and grading, screen analyses, concentration with gravity separation apparatus, etc.

60. Ore Dressing. H. E. T. Haultain, F. C. Dyer.

Departments 2 and 8, IV Year; 1 hr. per week, both terms.

Course 58 continued, study of flow sheets and special problems.

61. Ore Dressing. F. C. Dyer.

Departments 2 and 8, IV Year; 6 continuous hrs. per week, first term.

Advanced work with ore dressing appliances, ore testing and check mill runs.

62. Ore Dressing. F. C. Dyer.

Department 6m, IV Year; 1 hr. per week, both terms.

General principles of Ore Dressing.

63. Ore Dressing. F. C. Dyer.

Department 6m, IV Year; 1 period of 6 hrs. per week, second term.

Principles of sampling, crushing and grading, screen analyses, concentration with gravity separation apparatus, flotation, ore testing, etc.

64. Physics of Ore Dressing. F. C. Dyer.

Department 2 and 8, III Year and Department 6m, IV Year; 1 hr. per week, both terms.

Ore dressing methods involve a study of the laws governing the phenomena of surface tension, capillarity and colloidal solutions, in addition to those of hydrostatics and certain phases of hydraulics. This is embodied in a special course of lectures in conjunction with laboratory work in the ore dressing laboratory.

65. Theory of Measurements. H. E. T. Haultain, F. C. Dyer.

Department 2, II Year; 1 hr. per week, first term.

This title is not an entirely suitable one for this course of lectures because it is generally applied to a study of the philosophy of extremely accurate measurements. The mining engineer has to continually make satisfactory use of measurements with a wide range of inaccuracy. This course of lectures deals with the philosophy underlying the causes of these errors and the practical application of such approximations. The opportunity is taken in these lectures to deal with the subject of illustrating measurements by graphs.

66. Introductory Research. H. E. T. Haultain, F. C. Dyer.

Department 2, III Year; 3 hrs. per week, first term.

This is a laboratory course including some lectures and is a preparation for the thesis of the Fourth Year.

67. Thesis.

Department 2, IV Year; 7 hrs. per week, first term; 10 hrs. per week, second term, in continuous periods.

Thesis in this department consists mainly in reports on original work done in the laboratories. In the Third Year the subject "Introductory Research" paves the way for the thesis. By October 15th the student decides in the subject of his thesis in consultation with his professors. After this is decided the student uses his own initiative in the development of his work.

The thesis is divided into three parts. The first part, which is handed in not later than October 15th, contains the title, a statement of what the title is meant to convey and an outline of the work that is proposed to be done. The second part is handed in during the first week of January and contains a report of progress to date and enables the professor in charge to keep in closer touch with the work. The third and final part is handed in a week before the examinations and is a report of progress to date with final conclusions. The three parts combined constitute the thesis.

68. Vacation Work. H. E. T. Haultain, W. A. Parks.

Department 2, II Year.

Construction notes are required. Special instructions will be issued concerning these.

69. Vacation Work. H. E. T. Haultain.

Department 2, III Year.

This is a series of letters written during the summer vacation, dealing with various aspects of a mining engineer's work. These are intended to direct and help the student's powers of observation, analysis and criticism as well as being exercises in the art of lucid technical expression.

Special instructions will be issued in connection with these letters.

70. Vacation Work. H. E. T. Haultain.

Department 2, IV Year.

Special instructions will be given in connection with this work.

ASTRONOMY AND GEODESY

71. Astronomy, Elementary. P. M. Millman.

Department I, II Year; 1 hr. per week, both terms.

A course in descriptive Astronomy, explaining the ordinary astronomical terms, and describing the various celestial bodies and their motions. In the evenings opportunity will be given for identifying the stars and for observing with telescopes.

Text book: Elements of Astronomy—Fath.

72. Astronomy and Geodesy. S. R. Crerar.

Department 1, III Year; 2 hrs. per week, both terms.

The course of lectures deals with the determination of time, latitude, longitude and azimuth, by methods adapted to the use of the surveyor's transit and the sextant. It is designed to fulfil the requirements of the final examinations for Ontario and Dominion Land Surveyors.

In Geodesy an account is given of the principles and methods of a secondary triangulation survey, also of the principles involved in the North-west system of survey.

Text books: Practical Astronomy as applied to Geodesy and Navigation—Doolittle. Notes on Practical Astronomy and Geodesy. Nautical Almanac.

73. Field Work. S. R. Crerar.

Department 1, III Year; about 2 hrs. per week, first term.

The practical work in this subject comprises observations in the field with the transit and sextant for the determination of time, latitude and azimuth by the methods described in the lectures and the solution of related problems.

74. Astronomy (Advanced). J. W. Melson.

Department 1b, IV Year; 2 hrs. per week, both terms.

The lecture course in this subject comprises the theory and adjustment of the instruments used in connection with a geodetic survey; the methods of taking and reducing observations for time, longitude, latitude, and azimuth. with the precision required on such a survey; and other matters relating to these subjects.

75. Geodesy and Metrology. W. M. Treadgold.

Department 1b, IV Year; 2 hrs. per week, both terms.

The lecture course includes a description of the methods of measuring base lines and the angles of a triangulation; the geometry of the spheroid with applications to geodetic problems; the computation of geodetic positions; the solution of large triangles on the earth's surface, and the adjustment of a triangulation; trigonometric and precise spirit levelling; the determination of the figure of the earth by arc measurements, and by the pendulum; the theory of map projections, etc.

76. Astronomy, Geodesy and Metrology. W. M. Treadgold, J. W. Melson.

Department 1b, IV Year; about 23 hrs. per week, both terms.

The practical work in the above subjects includes the observation of meridian transits for time and longitude determinations, and of prime vertical transits for latitude, with the astronomical transit instrument; the observation of meridian zenith distances of stars, and of azimuths at elongation for latitude, with the alt-azimuth;

theodolite observations for azimuth; observations for latitude with the zenith telescope; the investigation of the constants of the instruments used, and the reduction of all observations; the measurement of a base line with the steel tape and with invar wires, and the determination of the constants of the tape; the measurements of the angles of a triangulation and the adjustment of the angles of network of triangles, etc. A portion of this work will be taken at the University Survey Camp. (See course 275.)

BIOLOGY

80. Elementary Biology. A. J. V. Lehmann.
Department 6, I Year; 3 hrs. per week, second term.
A lecture and laboratory course on biological principles.

CHEMISTRY

84. General Chemistry. E. G. R. Ardagh, E. A. Smith.
Departments 1, 2, 3 and 7, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.
An advanced course in inorganic chemistry with industrial applications.

85. General Chemistry. E. G. R. Ardagh, E. A. Smith.
Departments 5, 6 and 8, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.
An advanced course in chemical theory, with experimental illustrations.

86. Inorganic Chemistry. L. J. Rogers.
Department 5, I Year; 3 hrs. per week, both terms.
Department 6, I Year; 12 hrs. per week, both terms.
A laboratory course of quantitative experiments illustrating the use of the sensitive balance, and confirming the fundamental laws of chemistry; qualitative inorganic analysis; quantitative analysis of pure salts.
Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

87*a*. Inorganic Chemistry A. E. G. R. Ardagh.
Departments 1, 2, 3, 6, 7 and 8, II Year; 1 hr. per week, first term.
A continuation of courses 84 and 85 dealing principally with the metals.

87*b*. Inorganic Chemistry B. E. G. R. Ardagh.
Departments 2, 6 and 8, II Year; 1 hr. per week, second term.
A continuation of courses 84 and 85.
Text book: General Chemistry—Deming.

88. Analytical Chemistry. L. J. Rogers.
Departments 2, 6 and 8, III Year; 1 hr. per week, both terms.
A lecture course on the principles of chemical analysis; select gravimetric and volumetric methods; technical analysis.

89. Analytical Chemistry. E. A. Smith, R. R. McLaughlin.
Departments 1 and 3, II Year; 6 hrs. per week, second term.
Department 2, II Year; 6 hrs. per week to Dec. 1st.
Department 7, II Year; 6 hrs. per week, first term.
Laboratory course in qualitative and quantitative analysis.

90. Analytical Chemistry. E. A. Smith.
Department 2, II Year; 6 hrs. per week, from Dec. 1st.
A laboratory course in the gravimetric determination of metals and acids, with elementary volumetric analysis.

91. Analytical Chemistry. L. J. Rogers.
Department 8, II Year; about 14 hrs. per week, first term; about 13 hrs. per week, second term.
A laboratory course comprising gravimetric and volumetric methods, acidimetry and alkalimetry.
Text books: Analytical Chemistry, Vol. II—Treadwell Hall. Qualitative Chemical Analysis—A. A. Noyes.

92. Analytical Chemistry. L. J. Rogers.
Department 6, II Year; about 100 hrs., to Dec. 1st.
A laboratory course in quantitative chemical analysis; inorganic preparations.
Text book: Analytical Chemistry, Vol. II—Treadwell-Hall.

93. Engineering Chemistry. J. W. Bain.
Departments 1, 3, 5, 6 and 7, II Year; 1 hr. per week, first term.
A lecture course consisting of a study of the industrial production and application of heat, and of the chemistry of fuel and the products of combustion.

94. Industrial Chemistry. J. W. Bain.
Department 6, II Year; 1 hr. per week, both terms.
A lecture course on the manufacture of salts, acids, alkalies and inorganic chemicals.

94*a*. Industrial Chemistry. E. G. R. Ardagh.
Department 6, II Year; about 70 hrs., second term.
An introductory laboratory course in industrial chemistry.

95. Organic Chemistry. M. C. Boswell.
Departments 1, 3 and 7, II Year; 1 hr. per week, second term.
A lecture course in elementary organic chemistry.

96. Organic Chemistry. M. C. Boswell.

Department 6, II Year; 2 hrs. per week, both terms.

A discussion of the chemistry of compounds of the methane, ethylene and acetylene series, and of the details of laboratory procedure in the carrying out of typical reactions. This course is accompanied by laboratory course 97.

97. Organic Chemistry. M. C. Boswell, R. R. McLaughlin.

Department 6, II Year; about 115 hrs., second term.

A laboratory course accompanying lecture course 96. The work consists in the synthesis of compounds and a study of their properties.

98. Physical Chemistry. F. B. Kenrick.

Departments 5 and 6, II Year and Department 8a, III Year; 2 hrs. per week, both terms.

A course of lectures on the elements of chemical mechanics, and the theory of solutions.

99. Analytical Chemistry. L. J. Rogers.

Department 2, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.

A laboratory course on the technical analysis of ores and furnace products.

100. Industrial Chemistry. E. G. R. Ardagh.

Department 6, III Year; 175 hrs.

A laboratory course in industrial chemistry.

101. Analytical Chemistry and Phase Rule. L. J. Rogers, J. T. Burt-Gerrans.

Department 8, III Year; about 6 hrs. per week, second term.

A laboratory course in analysis and phase rule.

102. Engineering Chemistry. J. W. Bain, E. G. R. Ardagh.

Departments 1, 2, 3, 6, 7, 8 and 8a, III Year; 1 hr. per week, both terms.

A lecture course on the application of chemistry to engineering problems: air, water, corrosion of metals, explosives, petroleum products, rubber, synthetic resins, etc.

103. Industrial Chemistry. E. G. R. Ardagh.

Department 6, III Year; 1 hr. per week, both terms.

A lecture course on petroleum and its products, coal tar and its products, fats, oils, soap, sugar, starch, rubber, fermentation industries, etc.

104. Chemical Plant. J. W. Bain.

Department 6, III Year; 1 hr. per week, both terms.

A lecture course on the machinery and plant used in chemical manufacturing.

105. Organic Chemistry. M. C. Boswell.

Department 6, III Year; 2 hrs. per week, both terms.

A lecture course on the general reactions and methods of synthesis of compounds of the benzene, naphthalene and anthracene series, with special reference to the essential laboratory conditions under which typical reactions are brought about and to the methods for isolating reaction products from reaction mixtures. This course is accompanied by laboratory course 106.

106. Organic Chemistry. M. C. Boswell, E. A. Smith, R. R. McLaughlin.

Department 6, III Year; 125 hrs.

A laboratory course accompanying course 105. The work consists in the synthesis of compounds and a study of their properties.

107. Electrochemistry. W. L. Miller, J. T. Burt-Gerrans.

Departments 6, 7 and 8, III Year; 2 hrs. per week, first term.

A lecture course on elementary electrochemistry, illustrated by experiments.

108. Electrochemistry. W. L. Miller, J. T. Burt-Gerrans.

Departments 6, 7 and 8, III Year; 3 hrs. per week, first term.

A laboratory course in quantitative measurements to accompany course 107.

109. Inorganic Chemistry. J. W. Bain.

Department 6, IV Year; 2 hrs. per week, both terms.

A lecture course on chemical theory.

110. Organic Chemistry. M. C. Boswell.

Department 6, IV Year; 1 hr. per week, both terms.

A lecture course dealing with (1) catalysis in organic chemistry, particularly as applied to the industry, (2) the influence of relatively small alterations in the conditions upon the yield of organic reactions, and (3) the chemistry of proteids, carbohydrates and tannins.

110*a*. Organic Chemistry. M. C. Boswell.

Department 5, III Year; 1 hr. per week, both terms.

A lecture course on the general reactions and methods of synthesis of carbon compounds.

Text book: Organic Chemistry—Perkin and Kipping.

111. Organic Chemistry. M. C. Boswell, E. A. Smith, R. R. McLaughlin.

Department 6, IV Year.

A laboratory study of some reactions used in industrial synthesis, particularly those involving the use of catalysts. Oxidation, reduction, dehydration, hydrogenation, and chlorination reactions are are carried out catalytically in the hydrogenation of liquid fats, the production of elementary sulphur from sulphur dioxide, the chlorination of methane, and the synthesis of formaldehyde, aniline, and ethylene glycol, and the efficiencies of the processes studied. These

reactions along with the synthesis of two triphenyl methane dyes, salicylic acid and three of its derivatives, afford experience in the setting up of apparatus of a more complicated kind involving the standardization and use of the thermocouple, the gas flowmeter, the autoclave, the vacuum drier and evaporator.

112. Industrial Chemistry. J. W. Bain.
Department 6, IV Year; 1 hr. per week, both terms.
A lecture course on selected subjects in chemical technology.

113. Research. The senior staff in Chemical Engineering.
Department 6, IV Year.
In this course, which occupies about three-quarters of the total time of the year, a research problem is given to each student. This provides experience in searching the primary sources of scientific information and in devising analytical methods and designing apparatus applicable to the new problems. Each student is obliged to write a thesis embodying the results of his search of the original literature and his own experimental work. Thus this course serves as a preparation for the field of research work; and those students who, by ability, taste, and temperament, are fitted for research pass naturally either into industrial research or into the graduate school of the University to pursue further work in this field.

114. Electrochemistry. J. T. Burt-Gerrans.
Department 6e, 7e, and 8, IV Year; 2 hrs. per week, both terms.
An advanced lecture course on the theory of solutions and electrolysis, and the application to the practice of electro-deposition and electrolytic refining of metals. The course also includes lectures on the electric furnace with special consideration of efficiency.
Reference books: Electrometallurgy—Borchers. Electrochemistry—Le Blanc. Electrochemistry—Luepke. Principles of Applied Electrochemistry—Allmand and Ellingham. The Electric Furnace—Stansfield. The Electric Furnace—Pring.

115. Electrochemistry. J. T. Burt-Gerrans.
Departments 6e, 7e and 8, IV Year.
A laboratory course accompanying course 114.

116. Sanitary and Forensic Chemistry. J. W. Bain.
Department 6, IV Year; 1 hr. per week, both terms.
A lecture course on the composition and examination of air, water and food; poisons and their detection, with accompanying laboratory course.

116*a*. Silicate Chemistry. J. B. Ferguson.
Department 8a, IV Year; 2 hrs. per week, first term.
The application of phase rule to the chemistry of refractory materials.

ECONOMICS AND BUSINESS ADMINISTRATION

121. Business. R. R. Grant.

Departments 1, 2, 3, 6, 7, 8, I Year; 1 hr. per week, second term.

A lecture course on the principles underlying accounting and general business methods of a simple nature in order to enable the student to understand simple financial reports.

122*a*. Technical English. W. J. T. Wright.

All Departments, I Year; 1 hr. per week, both terms.

A lecture course on the expression of ideas and the compilation and writing of engineering reports and letters; technical exposition; the necessity of accurate expression in professional writing; the value of reading.

122*b*. English. W. J. T. Wright.

Department 4, II Year; 1 hr. per week, both terms.

This course of lectures includes a discourse on the literature which refers either directly or indirectly to architecture and the arts. Books are reviewed and discussed in round-table talks.

123. Economics and Finance. C. H. Mitchell.

All Departments, II Year; 1 hr. per week, both terms.

An introduction to the study of Economics. The course will deal in an elementary manner with the following:

(1) Scope of Economics.
(2) Economic Geography.
(3) Theory of Value, Supply and Demand.
(4) Theory of Production and Distribution.
(5) Structure of Industry and Social Conditions.
(6) Money, Banking and Finance.
(7) Economics of Canada with special reference to the relation of Engineering to Finance.

Text books: Economics for the General Reader—Clay. Supply and Demand—H. D. Henderson. Annual Financial Reviews.

124. Commercial Law. F. C. Auld.

Departments 4 and 7, III Year; Department 8a, IV Year; 1 hr. per week, both terms.

General Principles of the Law of Contracts, Principal and Agent, Partnership and Limited Companies with special reference to the Companies Acts. General view of the following:—Negotiable Instruments, Sale of Goods, Bills of Sale and Chattel Mortgages, Suretyship and Guarantee.

Text book: Stephens' Elements of Mercantile Law (6th Edition.)

125. Engineering Economics. C. R. Young.

Departments 1, 2, 3, 7 and 8, IV Year; 1 hr. per week, second term.

A series of lectures on the principles by which the economic practicability of a project is judged and the comparison of competing proposals is made. Consideration is given to first cost and annual cost, methods of estimating, fixed charges and operating expenses, valuation and appraisals. Special attention is given to depreciation and the methods of providing for it. Typical numerical problems are discussed and solved.

Text books: Engineering Economies—Fish. Financial Engineering—Goldman. Principles of Engineering Economy—Grant.

126. Engineering Law. R. E. Laidlaw.

Department 1, IV Year; 1 hr. per week, first term.

A course of lectures, co-ordinating Engineering practice and Law as contained in various legislation such as: The Railway Act, Municipal Act, Public Health Act, Arbitration Act, Workmen's Compensation Act, Patents, Copyrights, etc.

127. Contracts and Specifications. C. R. Young.

Departments 1, 4, 8, and 8a, IV Year; 1 hr. per week, second term.

This course of lectures deals with the fundamental principles of contract and specification writing. The critical examination of typical specifications and agreements by the class, forms an essential feature of the instruction.

Text book: Elements of Specification Writing—Kirby.

128. Management. C. R. Young.

Department 1, IV Year; 1 hr. per week, first term.

A series of lectures dealing with the fundamental principles upon which management is based. The possibilities of effective management are indicated and its basis is shown to exist in suitable organization, adequate equipment and smooth administration.

Text books: Construction Cost Keeping and Management—Gillette and Dana. Principles of Industrial Organization—Kimball. Principles of Industrial Management—Allcut.

129. Plant Management. G. A. Guess.

Department 8 and 8a, IV Year; 1 hr. per week, second term.

A course of twelve lectures dealing with some phases of labour, plant organization, smelter contracts and markets.

130. Industrial Management. E. A. Allcut.

Departments 3, 6 and 7, IV Year; 1 lecture per week, both terms.

This course includes a study of industrial organization, location, arrangement, construction and equipment of industrial plants for efficiency and economy, process routing, scheduling work, reports, methods of superintending, employment, systems of compensating labour and systems of distributing indirect expenses.

Text book: Principles of Industrial Management—Allcut.

131. Municipal Administration. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. per week, second term.

A lecture course dealing with municipal government, assessment and taxation, municipal finance, public utilities, expropriation, annexation problems, town planning, local improvement and other laws relating to municipalities.

133. Public Speaking. F. H. Kirkpatrick.

Department 1, II Year, 1 hr. per week, second term.

Department 4, III Year; 1 hr. per week, first term.

A course on the principles of public speaking and the means of expression, accompanied by practical application and training in actual speaking.

ELECTRICITY

135. Electricity. H. W. Price.

Departments 1, 2, 3, 5, 6, 7 and 8, I Year; 2 hrs. per week, both terms.

A course of lectures on basic principles relating to electric circuits, magnetic circuits, instruments and apparatus in general, distribution of electrical energy, etc., illustrated largely from commercial apparatus. The point of view of this work is quantitative rather than descriptive, for it is believed that men who can solve engineering problems are most likely to grasp underlying principles.

136. Electricity. V. G. Smith.

Departments 3, 5, 6, 7 and 8; II Year; 2 hrs. per week, both terms.

A course of lectures on the general principles and calculation of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power and energy. The principles underlying commercial instruments are considered together with the methods of calibration.

Reference Books: Electrical Measurements—Laws. Electrical Measurements in Theory and Application—Smith. Electrical Measurements and Measuring Instruments—Golding.

137. Electrical Laboratory. V. G. Smith.

Departments 3, 6, 7 and 8; II Year; 3 hrs. per week, both terms.

Department 5, II Year; 3 hrs. per week, first term.

The more important methods of measurement of resistance, current, potential difference, inductance, and capacity are used, often under conditions such as occur in practice. The principles of measurement are applied to other problems such as the location of line faults and the measurement of temperature rise by resistance changes. Methods of calibrating commercial instruments are also included.

138. Magnetism and Electricity. A. R. Zimmer.

Department 3, III Year; 1 hr. per week, both terms.

Departments 5 and 7, III Year; 2 hrs. per week, first term; 1 hr. per week, second term.

A course of lectures on theory of magnetism and magnetic circuits, theory of direct-current generators, motors, etc.

Reference Books: Electrical Engineering, Vol. I—Dawes. Electrical Circuits and Machinery, Vol. I—Morecroft and Hehre. Electricity and Magnetism for Engineers, Part I—Pender. Principles of D.C. Machines—Langsdorf. Direct-Current Machinery—Pender.. Electrical Engineering—Christie. Elements of Electrical Engineering—Cook.

139. Alternating Current. A. R. Zimmer.

Department 3, III Year; 1 hr. per week, both terms.

Departments 5 and 7, III Year; 1 hr. per week, first term; 2 hrs per week, second term.

A first course of lectures on alternating current, covering principles of measurement and leading to the analytical and graphical treatment of the simpler problems relative to alternating-current circuits and machinery.

Reference Books: Electricity and Magnetism for Engineers, Part II—Pender. Electrical Engineering—Christie. Electrical Engineering, Vol. II—Dawes. Electrical Circuits and Machinery, Vol. II—Morecroft and Hehre. Alternating Current Electrical Engineering—Maccall. Alternating Current Electrical Engineering—Kemp. Elements of Electrical Engineering—Cook.

140. Electrical Laboratory. A. R. Zimmer.

Department 3, III Year; 4½ hrs. per week first term, 3 hrs. per week second term.

Departments 5 and 7, III Year; 6 hrs. per week, both terms.

This laboratory course is intended to afford the student an opportunity to become familiar with principles involved in continuous-current shunt, series and compound-wound generators and motors; and, to some extent, alternating-current circuits and machinery. Other sections of the work deal with the magnetic properties of iron and steel, and study of iron losses in transformers and generators.

The course is arranged to stand in close relation to the lecture courses in the subjects of magnetism and electricty and alternating current (courses 138 and 139) for III Year, and to certain design work (course 141).

141. Electrical Design. H. W. Price.

Department 7, III Year; 1 hr. per week, both terms.

A course of lectures dealing with design of electrical apparatus and machinery, accompanied by designs to be worked out in the design room.

142. Electrical Design Laboratory. H. W. Price.

Department 7, III Year; 3 hrs. per week, both terms.

A design room is set apart for working out designs of electrical apparatus such as transformers, generators, motors, auxiliary apparatus, etc.

Special forms and notes are employed, arranged to suit the various studies. Certain models are provided to assist where necessary.

143. Electricity. H. W. Price.

Departments 6, 8 and 8a, III Year; Departments 1 and 2, II Year; 1 hr. per week, both terms.

A course of lectures dealing with fundamental calculations of alternating current circuits and various applications of interest to those who are not making electricity a major subject.

144. Electrical Laboratory. H. W. Price, A. R. Zimmer.

(*a*) Department 1, II Year; 3 hrs. per week, second term.

(*b*) Department 2, IV Year; 3 hrs. per week, first term.

(*d*) Department 6, III Year; 3 hrs. per week, second term.

(*e*) Department 8, III Year; 3 hrs. per week, both terms.

(*f*) Departments 8a, III Year; 3 hrs. per week, second term.

These courses are arranged to suit the requirements of the departments concerned. The experiments are planned with the idea of affording a general knowledge of circuits, power measurements, direct-current and alternating-current machinery and transmission of power.

Reference Books: Elements of Electrical Engineering—Cook.

145*a*. Applied Electricity. T. R. Rosebrugh.

Symbolic and Graphical Methods.

Department 7, IV Year; 2 hrs. per week, both terms.

Complex quantities and their use in a.c. problems. Loci for current and voltage vectors for given limitations on circuit constants. Short line distribution circuit loci; approximate graphical theory of synchronous motor.

Reference Books: Principles of Alternating Currents—Lawrence. Alternating Current Circuits—Weinbach.

145*b*. Applied Electricity. T. R. Rosebrugh.

Wave Form and Transmission Line.

Department 7, IV Year; 1 hr. per week, both terms.

Non-sinusoidal alternating current waves, analysis of waves, forms of symmetry, three phase limitations, elimination of undesired harmonics, heating of rotary converters; power, current, and voltage readings as influenced by wave form.

145*c*. Applied Electricity. H. W. Price.

Alternating Current Machinery and Measurements.

Department 7, IV Year; 2 hrs. per week, both terms.

Polyphase alternating-current measurements of power, reactive power, apparent power, finding the indications of meters from given wiring diagrams, constructing wiring diagrams to obtain required meter indications. Potential and current transformers. Meter indications with distorted wave forms. Power transformers. Properties of alternators; induction motors of squirrel cage and wound-rotor types; synchronous motors; regulators; current-limiting reactors; arresters; and other general apparatus.

146. Electrical Laboratory. A. R. Zimmer.

Department 7, IV Year, in connection with course 145; 20 hrs. per week, both terms.

This laboratory course involves a thorough study of principles and properties of single-phase and polyphase circuits and apparatus. Both vector and analytical methods are applied to the solution of problems based on tests made on laboratory machines.

The work deals mainly with constant-voltage and constant-current transformers, single and polyphase alternators, synchronous motors, rotary converters, induction and single-phase commutating motors, transmission line, etc. The work does not consist only of factory tests, but is designed to lead the student to apply theory to practice as illustrated in the apparatus under test, with a view to an exact understanding of methods and an appreciation of limitations under many conditions. Free use is made of the oscillograph as a necessary device for "seeing" conditions under investigation. The best commercial measuring instruments are available.

Reference Books: Electrical Engineering—Christie. Experimental Electrical Engineering, Vols. I and II—Karapetoff.

147. Radiotelegraphy. T. R. Rosebrugh.

Department 7r, IV Year, in connection with course 148; 2 hrs. per week, both terms.

Natural oscillations of simple and simply coupled circuits. Action of C.W. on circuits of the most general character. Radiation of antennas. Theory of modulation in radiotelephony. Energy control and transformation by vacuum tubes.

Reference Books: Differential Equations for Electrical Engineers —Franklin.

148. Radiotelegraph Laboratory. B. de F. Bayly.

Department 7r, IV Year, in connection with course 147; 9 hrs. per week, both terms.

The work in this laboratory covers the principles and the technique of measurements at radio frequencies. This includes measure-

ments of wave length, resonance, coupled circuits, inductance, capacity, energy distribution, resistance, etc., at radio frequencies.

Considerable work is also done with the three electrode vacuum tube and its uses in radio and audio-frequency circuits.

Reference Books: Communication Engineering—Everitt. Alternating Current Bridge Methods—Hague. High Frequency Measurements—Hand.

149. Acoustics. B. de F. Bayly.

Department 7r, IV Year; one hr. per week, first term.

The principles of recording, transmission, and reproduction of sound in connection with electrical systems. Mechanical vibrating systems; microphones; loud speakers; causes of distortion; principles of hearing; reverberation.

Reference Books: Elements of Engineering Acoustics—Hughes. A Text Book of Sound—Wood. Acoustics—Stewart and Lindsay.

ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY

160. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3, 5, 6, 7 and 8, I Year; 1 hr. per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solutions of problems relating to straight lines and planes.

161. Descriptive Geometry. J. R. Cockburn.

Department 4, I Year; 1 hr. per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solution of problems relating to straight lines and planes, special reference being made to the determination of shades and shadows.

162. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3 5, and 7, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of the work taken in the First Year with the following additions: problems relating to curved surfaces, principles of shades, shadows and perspective.

163. Descriptive Geometry. J. R. Cockburn.

Department 4, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of the work taken in the First Year with the addition of problems relating to curved surfaces, shades, shadows and perspective.

164. Descriptive Geometry. J. R. Cockburn.

Department 1, III Year; 1 hr. per week, first term.

This course of lectures deals with spherical projections, the principles of mapmaking, and the graphical solution of spherical triangles.

166. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Department 1, I Year, 10 hrs. per week, first term, 17 hrs. per week, second term; Department 2, I Year, 9 hrs. per week, first term, 12 hrs. per week, second term; Department 3, I Year; 9 hrs. per week, first term; 15 hrs. per week, second term; Department 7, I Year; 12 hrs. per week, first term, 17 hrs. per week, second term; Department 8, I Year; 11 hrs. per week, first term, 18 hrs. per week, second term.

Copying from the flat, lettering, topography; graphical solution of problems in statics; problems in descriptive geometry, relating to both orthographic and oblique projections; the plotting of original surveys; measured drawings.

167. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Department 4, I Year.

Lettering, the graphical solution of problems in statics; problems in descriptive geometry, relating to both orthographic and oblique projections; measured drawings.

168. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Department 6, I Year; 2 hrs. per week, first term; 3 hrs. per week, second term.

Copying from the flat, lettering, graphical solution of problems in statics, problems in descriptive geometry.

169. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Departments 1 and 2, II Year. Department 1, 5 hrs. per week, first term; 10 hrs. per week, second term; Department 2, 3 hrs. per week, first term; 10 hrs. per week, second term.

Colouring and shading as applied to both topographical and construction drawings; problems in descriptive geometry relating to solids bounded by curved surfaces; principles of shades, shadows and perspective; solution of problems in optics and strength of materials; measured drawings; elementary design.

170. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Departments 3 and 7, II Year; Department 3, 14 hrs. per week, first term; 6½ hrs. per week, second term; Department 7, 9½ hrs. per week, first term; 14½ hrs. per week, second term.

Colouring and shading as applied to construction drawings; problems in descriptive geometry relating to solids bounded by curved surfaces; principles of shades, shadows and perspective; solution of problems in optics, theory of mechanism and strength of materials; measured drawings; elementary design.

171. Engineering Drawing. J. R. Cockburn.

Department 4, II Year.

Principles of shades, shadows and perspective; problems in descriptive geometry relating to solids bounded by curved surfaces; solution of problems in strength of materials.

172. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Department 6, II Year; 7 hrs. per week, first term; 3 hrs. per week, second term.

Department 8, II Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

173. Engineering Drawing. W. B. Dunbar.

Department 1, III Year; 13 hrs. per week, first term; 14 hrs. per week, second term.

Principles of mapmaking, spherical projection; problems in theory of construction; original design of various structures.

174. Engineering Drawing. W. B. Dunbar.

Department 2, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.

Problems in theory of construction; original design.

177. Engineering Drawing. W. B. Dunbar.

Departments 3, 6 and 8a, III Year; Department 3, 6 hrs. per week, first term; 3 hrs. per week, second term; Department 6, 3 hrs. per week, both terms; Department 8a, 6 hrs. per week, first term; 5 hrs. per week, second term.

Problems in design dealing with the theory of structures.

178. Structural Design Drawing. W. J. Smither.

Department 1 (a), IV Year; 15 hrs. per week, both terms.

Problems in structural design.

180. Structural Design Drawing. W. J. Smither.

Department 3, IV Year; 3 hrs. per week, first term.

Problems in mill building design.

182. Engineering Drawing. W. B. Dunbar.

Department 8, III Year; 3 hrs. per week, first term.

Plotting metallurgical flow sheets.

183. Structural Design Drawing. W. J. Smither.

Department 8 (a), IV Year; 6 hrs. per week, both terms.

Of this time half in the first term is devoted to problems in mill building design bearing on lecture course 18. The remainder of the time in the first term and the whole time in the second term is devoted to the original design of ceramic plants, driers, kilns, etc.

184. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Department 5, I Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

The graphical and analytical solution of problems involving descriptive geometry, applied mechanics and mathematics.

APPLIED PHYSICS

185*a*. Applied Physics. The Staff in Applied Physics.

Departments 3 and 7, I Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the production and distribution of light, photometry and illumination, optics and optical instruments.

185*b*. Optics. K. B. Jackson.

Department 6, I Year; 1 hr. lecture per week, both terms, 3 hrs. laboratory per week, first term.

A course of lectures with laboratory work on light, geometrical and physical optics, and optical instruments.

186. Applied Physics Laboratory. The Staff in Applied Physics.

Department 6, II Year; 1 hr. laboratory per week, second term.

A short laboratory course supplementing 185b in Optics and course 212 in Hydrostatics.

187. Applied Physics. The Staff in Applied Physics.

Department 1, I Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

A course of lectures and laboratory work on optics and optical instruments, the projection of light and its applications in marine and railway signalling, flood lighting, etc.

188. Photography. K. B. Jackson.

Department 4, II Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the principles of photography, photographic equipment, materials, and processes, with special reference to architectural photography and an outline of the photo-mechanical processes.

188*a*. Photography Applied to Research. K. B. Jackson.

Senior and graduate students; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the principles of photography, the choice and use of equipment for special purposes, the photometry of projection, sensitometry and the correct use of photographic materials and processes.

189. Photographic Surveying. K. B. Jackson.

Department 1b, IV Year; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on photography, perspective, the calibration of a surveying camera, ground and aerial methods of photographic surveying, stereo-photogrammetry, accuracy and economy.

190. Light and Sound. The Staff in Applied Physics.

Department 4, III Year; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

An elementary course of lectures with laboratory work on the production, distribution, and measurement of light, sound, and electricity in preparation for course 191.

191. Acoustics and Illumination Design. K. B. Jackson.

Department 4, IV Year; 1 hr. lecture, 1 hr. laboratory per week, both terms.

A course of lectures with laboratory work on architectural acoustics, the properties and uses of acoustical materials, and the design of lighting installations for public and private buildings.

192. Photometry. K. B. Jackson.

Department 7i, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, first term; 1 hr. lecture, 3 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the production, distribution, and measurement of light and colour, the theory and application of visual and physical photometers, and the photometry of projection equipment.

192*a*. Illumination Design. K. B. Jackson.

Department 7i, IV Year; 1 hr. lecture, 6 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the theory and design of lighting equipment and installations.

GEOLOGY

193. Field Work. E. S. Moore.

Department 2, III Year; one week at the University Survey Camp preceding the opening of the first term.

194. Pleistocene Geology and Physiography. A. MacLean.

Departments 2 and 8a, IV Year; 1 hr. per week, both terms.

Pleistocene Geology. Lectures on the formation and distribution of the drift deposits of North America, with brief references to other regions. Glacial, interglacial, and postglacial beds are described, changes of climate are discussed with their probable causes, and the economic features of the clays, sands, and gravels are considered.

Physiography. A course of lectures on the surface forms of the earth, and on the geological factors that have produced them. The broad features of the earth, its plains, tablelands, hills, valleys, mountains, oceans, rivers, and lakes are discussed in a general way; methods of topographical surveying and mapping are referred to, and the chief physiographic areas of Canada are described.

Works of reference: Ice Ages, Recent and Ancient—Coleman. Physiography—Salisbury.

195. Elementary Geology. W. A. Parks.

Departments 1, 2, II Year; 2 hrs. per week, second term.

This course deals chiefly with historical geology with special reference to Canadian formations.

Works of reference: Introduction to Geology—Scott. Elementary Geology—Coleman and Parks.

196. Geology and Ore Deposits. D. R. Derry.

Department 8, II Year; 2 hrs. per week, both terms.

Lectures and laboratory work on historical, structural, and economic geology, designed to familiarize the student with the more important principles, facts, and terms of general geology.

Works of reference: As in course 195.

197. Engineering Geology. A. MacLean.

Departments 1 and 8a, III Year; 1 hr. per week, both terms.

This course deals with the application to engineering of dynamic, structural, and economic geology.

Works of reference: Engineering Geology—Ries and Watson.

198. Dynamic and Structural Geology. A. MacLean.

Department 2, II Year; 1 hr. per week, first term.

Lectures on geological forces and their effects. Particular attention is given to those aspects of the subject that apply in mining.

Works of reference: Geology—Emmons, Thiel, Stauffer and Allison.

199. Precambrian Geology. E. S. Moore.

Department 2, IV Year; 2 hrs. per week, first term.

Lectures on the Precambrian formations of Canada—their rocks, distribution, relationships, and economic features. Briefer accounts are given of similar formations in the United States and elsewhere.

Works of reference: Reports of the Geological Survey of Canada and of the Ontario Department of Mines. Reports of the United States Geological Survey.

200. Mining Geology. E. S. Moore.

Department 2, IV Year; 2 hrs. per week, second term.

A course of lectures on geological problems associated with mining, typical mining regions in Canada, the United States, and elsewhere being discussed from the geological side.

Works of reference: Mineral Industry. Geology Applied to Mining—Spurr; and the works mentioned under course 199.

201. Geological Excursions. A. MacLean.

Departments 2 and 8a, IV Year.

During October weekly trips will be made to points of interest near Toronto.

202. Economic Geology. E. S. Moore.

Department 2, III Year.

(*a*) Ore Deposits: 1 hr. per week, both terms.

Discussion of the origin and classification of ore deposits, the mode of occurrence of the chief ores, and statistics of production. Special attention is given to the metals mined in Canada.

(*b*) Economic Geology of the Non-metals: 2 hrs. per week, second term.

Lectures on the origin and mode of occurrence of the valuable non-metallic substances—coal, oil, building stone, gypsum, cement materials, etc.

Works of reference: Economic Geology—Ries. General Economic Geology—Emmons. Coal—Moore. Practical Oil Geology—Hager. Mineral Resources of Canada—Moore. Introduction to the Study of Ore Deposits—Hatch.

203. Economic Geology. E. S. Moore.

Department 2, III Year; 2 hrs. per week, second term.

Laboratory work on ores, manner of occurrence, vein structure, etc., also the examination and construction of geological maps and sections of typical mining regions.

HYDROSTATICS AND HYDRAULICS

205. Hydraulics. R. W. Angus.

Departments 1, 2, 3, 6 and 7, III Year; 2 hrs. per week, both terms.

This is a course of lectures in hydraulics devoted to the development and discussion of formulae relating to the flow of water in pipes, the measurement of discharge by various methods, such as orifices and weirs, the conditions of flow obtaining in open channels, artificial and natural, and in pipes flowing partially full, together with other kindred subjects.

The object of this course is to provide the student with a good working knowledge of the fundamental principles of hydraulics, such as are useful in practical work, and are necessary to the intelligent investigation of more advanced problems, such as the design of water supply, sewerage and irrigation systems, and water power plants.

Text book: Hydraulics for Engineers—Angus.

206. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Departments 1, 2, 3 and 7, III Year; one 3 hr. period per week, second term.

Department 6, III Year; average $1\frac{1}{2}$ hrs. per week, second term.

The work in this course is intended to illustrate the lecture course given in hydraulics and to give the student some working acquaint-

ance with the formulae derived. Experiments are made to determine the coefficients for orifices of the various types used in practice and for a weir. The results of these experiments are used in measuring the discharge in subsequent experiments on meters and for the determination of hydraulic resistances in various cases of flow in pipes. The complete course illustrates very fully the application of the course of lectures to actual cases.

207. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 1 lecture per week, both terms.

A course of lectures dealing with the various problems of unsteady flow such as occur in power plants, penstocks, etc. Much of the work is done by the process of arithmetic integration, and the lecture work is supplemented by problems solved by the students in the work rooms, the time for which is included in course 209. Surges, water hammer, stream flow data, etc., are discussed.

The problems of collection of water for power purposes, use of the mass curve, rainfall and evaporation, turbine governing, etc., are also treated as far as possible.

Text book: Hydraulics for Engineers—Angus.

208. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 2 lectures per week, both terms.

The most important question considered and to which most of the lectures are devoted is the theory of turbines and centrifugal pumps, the effect of the design on the speed, discharge and efficiency being fully taken up. The course includes the selection of turbines and pumps for given service; intakes, draft tubes and all matters connected with hydraulic power plants.

Text book: Hydraulics for Engineers—Angus.

209. Hydraulics. R. W. Angus, R. Taylor.

Department 7h, IV Year; 9 hrs. per week, first term, 6 hrs. per week, second term; Department 3, average of 7½ hrs. per week in 3 and 2 hr. periods.

A laboratory course devoted to experimental work on turbines of various types and centrifugal and turbine pumps and other similar devices. This experimental work is arranged to illustrate the lectures on turbine and pump design. The experiments are made on hydraulic models and on two large turbine pumps used in the laboratory supply, as well as on apparatus specially designed for instruction. Various methods of measuring water-power and the efficiency of machines are also given. A list of the equipment now available and which is used in this course, is given in Section XII.

210. Hydraulic Laboratory. R. W. Angus, R. Taylor.
Department 8, IV Year; 3 hrs. per week, second term.
A laboratory course of experiments on orifices, weirs, meters, etc. See course 206.

211. Hydraulics. R. W. Angus, R. Taylor.
Department 1a, IV Year; 1 hr. lecture per week, both terms.
Laboratory course of 1 three hr. period per week, first term.
The course of lectures deals with general hydraulic problems such as surges in pipe lines, water hammer, flow in open channels and backwater, mass curves, a general discussion of pumps and turbines.
The laboratory course consists of class room instruction and experiments bearing on the lectures.
Text book: Hydraulics for Engineers—Angus.

212. Hydrostatics. R. W. Angus.
Departments 3, 6 and 7, II Year; 1 hr. per week, second term.
Fluid pressure and its application in the design of engineering structures. Forces acting on the bottoms and ends of tanks; pressures on pipes, gates and walls; stability of dams; laws governing the equilibrium of floating bodies.

213. Properties of Fluids. G. R. Lord.
Department 3, I Year; 1 hr. per week, both terms.
This course of lectures is intended to prepare the student for work in hydraulics, thermodynamics and machine design.

214. Properties of Fluids. G. R. Lord.
Department 3, II Year; 1 hr. per week, both terms.
This lecture course is a continuation of Course 213.

THERMODYNAMICS AND HEAT ENGINES

216. Steam and Heat Engines. E. A. Allcut.
Departments 3 and 7, II Year; 1 lecture per week, both terms.
Departments 2 and 8, II Year; 1 lecture per week, first term.
A course of lectures dealing with the history and development of the steam engine with special reference to the theory and design of valves and valve operating mechanisms. The principles of heat engines and the various forms of heat engine are also discussed briefly.

217. Thermodynamics. E. A. Allcut.
Departments 3, 6 and 7, III Year; 2 lectures per week, both terms.
In this lecture course the laws of heat are used to develop the characteristic equation for a perfect gas and the use of thermal lines on the pressure-volume diagram. The properties of Carnot's cycle

are then considered, followed by application of these principles to the hot-air engine, internal combustion engine and air compressor. A consideration of the properties of vapours and their application to the steam engine cycle and refrigeration concludes the course.

218. Heat Engines. R. C. Wiren.

(*a*) Departments 3, 7, 8, and 8a, III Year; 1 lecture per week, both terms.

This course of lectures is intended to supplement the general lecture course in Thermodynamics by showing the practical application of the laws discussed therein. The laws of combustion, their application to the boiler practice and the generation and uses of steam are the principal points considered.

(*b*) Department 3, III Year; 1 lecture per week, both terms.

These lectures are a further development of the internal combustion work commenced in the Second Year, the influence of thermodynamic considerations on the design of heat engines, and problems in heat transfer, being discussed. The laws of heat transmission and their influence on Heating and Ventilation problems are also considered.

219. Thermodynamics and Mechanical Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, III Year; 1 three hr. period per week, both terms.

Department 7, III Year; 3 hrs. per week, first term.

Time to be in three-hr. periods in all cases.

This laboratory course is designed to assist in a clearer understanding of thermodynamics, machine design and mechanics of machinery. The work in thermodynamics consists in the setting of slide valves, indicating engines measuring the brake horse-power, simple engine and boiler tests and the testing of gas and gasoline engines under various conditions. The mechanical laboratory work deals with the efficiency of belts as well as of several machines of simple construction. An examination of lubricating oils is also made by means of well-known methods. Experiments are also made on the balancing of reciprocating and rotating masses.

220. Thermodynamics. E. A. Allcut.

Departments 3 and 7t, IV Year; 2 hrs. per week, both terms.

This is a continuation of course 217, the general thermodynamic theory being studied from the conception of the thermodynamic surface. The theory of the flow of gases and vapours through orifices, nozzles and pipes is then discussed, and its application to the various forms of turbine is outlined. Thermodynamic losses and their causes, as exemplified by the steam power plant, are studied in detail.

221. Heat Engines. E. A. Allcut.

Departments 3 and 7t, IV Year; 1 hr. per week, both terms.

The first part of the course deals with refrigeration and includes studies on reversed heat engines, as exemplified by air, vapour compression and absorption machines. The various cycles employed and the properties of refrigerating vapours are studied in detail. Applications of refrigeration, as in air conditioning and industrial processes, are also described.

The second part is devoted to internal combustion and begins with a discussion of the constant volume and constant pressure cycles together with their associated losses. The properties of the various liquid fuels and their influence on combustion in a cylinder are also studied. The course concludes with a consideration of high speed compression ignition engines and the problems associated therewith.

222. Thermodynamics. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, IV Year; average 7½ hrs. per week, and 7t, IV Year, 9 hrs. per week, first term, 6 hrs. per week, second term.

The work in this year is a continuation and extension of the work covered in the Third Year laboratory course. Careful tests are made of heaters and of engines of various types, such as simple, tandem and cross-compound steam engines; steam turbine; refrigerating machine; injectors and steam pumps, etc.; and an application is made of Hirn's analysis and the entropy diagram to the results obtained. A complete set of experiments is made on each machine and the result plotted so as to show clearly to the student the effect of various alterations in the adjustment of the engine on the resulting efficiency.

Several modern gas and gasoline engines give ample opportunity for the study of this type of engine, and facilities are provided for sampling the gas supply and exhaust.

Two experimental stacks and three boilers enable results to be obtained on boiler efficiency and chimney draft.

223. Thermodynamics. E. A. Allcut.

Departments 1, 8 and 8a, III Year; 1 lecture per week, both terms.

Department 2, IV Year; 1 lecture per week, both terms.

The general principles of thermodynamics, the properties of a perfect gas and their application to the Carnot cycle are first studied. This is followed by a consideration of the air compressor cycle, some details of air compressor operation and the theory of the flow of air through pipes and orifices. The properties of vapours and the principles of steam engine operation are also discussed.

224. Thermodynamics Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 1, III Year; eight 3 hr. periods, second term.
Department 6, III Year; average $1\frac{1}{2}$ hours per week, second term.
Departments 8 and 8a, III Year; 3 hrs. per week, second term.
Department 2, IV Year; 3 hrs. per week, first term.

A course of experiments with steam and gas engines, compressed air, etc.

225. Thermodynamics. E. A. Allcut, R. C. Wiren.

Department 5, III Year; 2 hrs. lecture per week, both terms, and 3 hrs. per week in the laboratory, second term.

The lecture course consists of a study of thermodynamic cycles and their application to engines, compressors, turbines and refrigerating machines. The properties and the limitations of the various working fluids are also considered in relation to their use in such machines.

The laboratory work comprises a series of experiments designed to show how the principles given in the lecture courses are applied in practice.

MACHINERY

228. Machines and Processes. W. G. McIntosh.

Department 3, I Year; 1 hr. per week, both terms.

In this lecture course the various machines and processes used in shops are treated in a simple manner, so as to acquaint the student with the nautre of such work. The course is largely descriptive.

229. Machinery. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 1, III Year; 1 lecture per week, both terms, and 1 three hour drafting board period per week, second term.

This course of lectures and work on the drafting board is intended to give the civil engineer some acquaintance with the machinery used in bridges, machinery for conveying and moving materials, shovels, pumping, etc. The drafting problems will be used to illustrate the lecture course.

230. Theory of Mechanism. R. Taylor.

Departments 3 and 7, II Year; lectures 2 hrs. per week and problems $1\frac{1}{2}$ hrs. per week, both terms.

This course of lectures treats of the elementary construction of machines and of the motions of the various parts. Methods of determining linear and angular velocities, methods for the solution of elementary problems involving forces and methods for the determination of the mechanical efficiency of machines are discussed.

Velocity diagrams, crank effort and torque diagrams are plotted. Cams, toothed gearing and various types and applications of trains of gearing are considered.

Text book: Theory of Machines—Angus.

231. Mechanics of Machinery. W. G. McIntosh.

Departments 3 and 7, III Year; 1 hr. per week, both terms.

This course is devoted to a consideration of accelerations in machines, acceleration and inertia forces and effects, balancing of machines, kinetic energy of machines, speed fluctuations, proper weight of fly-wheel.

Applications of the methods described are made to various machines, including engines, machine tools, link motions, etc., and the lecture work is followed up by the solution of numerous examples in the drafting room.

The methods of analysis employed are those developed in course 230.

Text book: Theory of Machines—Angus.

232. Elementary Machine Design. W. G. McIntosh.

Departments 3, 6 and 7, II Year; 1 hr. per week, both terms.

This is a preparatory course intended to familiarize the student with the different shop methods and processes, casting, forging, machining, etc., used in the production of machine parts, to enable him to make proper provision in the design of such parts to facilitate their production.

In addition, the various standards, machine and pipe threads, tapers, pipe fittings, etc., are described and mechanical drafting room practice explained. Tolerances, limits, fits and gauges are discussed.

Text book: Machine Drawing—Tozer and Rising.

233. Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Departments 3 and 7, III Year; 2 lectures per week, both terms.

The design work averages 8 hrs. per week for Department 3, and 4 hrs. per week for Department 7, the periods to be of not less than 2 hrs. duration.

The lectures in this course deal with the design of various machine elements, including screw threads for fastening and power transmission, shafting, bearings (journal, thrust, ball and roller), belts, pulleys, spur gears, fly-wheels, keys, clutches, springs, etc.

The problems worked out in the drafting room are planned to include the design of all of the above and with a view to developing the student's judgment and sense of proportion in design.

Text book: Design of Machine Elements—Faires.

234. Machine Design—W. G. McIntosh, G. H. Hally, T. C. Graham.

Departments 2, 6, 8 and 8*a*, IV Year; 1 lecture per week, both terms.

The design work occupies 3 hrs. per week for the second term only.

The lectures in this course deal with the design of various machine elements, particularly those likely to be met with in chemical and metallurgical plants, and in mining work.

The problems worked out in the drafting room are designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical and metallurgical apparatus, and mine machinery.

234*a*. Elementary Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 5, II Year; 1 lecture per week, both terms, and one three hour drafting board period per week, both terms.

This course of lectures and work on the drafting board is intended to give some acquaintance with the selection of materials and their use in the design and construction of machinery. Machine parts are analysed as to suitable materials, production methods, the nature and magnitude of the stresses encountered, the standard practice in detailing such parts.

Text book: Machine Design—Berard and Waters.

235. Advanced Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 3, IV Year; 2 lectures per week, both terms.

The design work averages 7 hrs. per week, the periods to be of not less than 2 hrs. duration.

The lectures of this course deal with the design of machine frames, hooks, hoisting equipment, crank shafts, gears of various kinds (herring-bone, bevel, screw) worm gearing, clutches and brakes.

The work in the drafting room is devoted to the design of complete machines with the object of giving the student practice not only in the design of various details, but also in working the various elements into a machine of smooth and harmonious design. The machines chosen as examples for design involve as many new machine elements as possible in order to broaden the training of the student.

Text book: Principles of Machine Design—Norman.

MATHEMATICS

See Advanced Mathematics, p. 104.

236. Calculus. S. Beatty, D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell.

All Departments, I Year; 2 hrs. per week, both terms.

Derivation of the fundamental formulae of the differential and integral calculus, with early applications to simple problems concerning graphs, areas, volumes, lengths, centres of gravity, and moments of inertia.

237. Calculus. S. Beatty, D. A. F. Robinson, Miss M. E. G. Waddell. C. E. Miller.

Departments 1, 3, 6 and 7, II Year; 2 hrs. per week, both terms.

Continuation of course 236. The elementary theory reviewed and extended. Special attention to applications with problems in engineering mostly in view. Introduction to the study of simple differential equations.

238. Analytical Geometry. S. Beatty, D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell.

All Departments, I Year; 1 hr. per week, first term, 2 hrs. per week, second term.

The course in Elementary Analytical Geometry covers the more familiar propositions in connection with the straight line, circle, parabola, ellipse and hyperbola. The subject is treated so as to illustrate the general methods of analytical geometry.

239. Spherical Trigonometry. J. W. Melson.

Department 1, II Year; 1 hr. per week, first term.

A course of lectures includes the derivation of formulae and their application to the solution of triangles and to practical problems.

Text book: Spherical Trigonometry—Todhunter and Leatham.

240. Method of Least Squares. J. W. Melson.

Department 1, II Year; 1 hr. per week, second term.

The course of lectures includes: The general principles of probability, the law of error, direct measurements of equal and different weights; mean square and probable errors; indirect measurements; conditioned observations; applications to empirical constants and formulae, etc.

Text book: Least Squares—Merriman.

METALLURGY

241. Elementary Metallurgy. G. A. Guess.

Departments 2, 3, 6 and 8, II Year; 1 hr. per week, second term

A course of about 12 lecturcs on furnace metallurgy and present practice, with special reference to iron and steel.

242. Fuels and Combustion. G. A. Guess.

Department 8, II Year; 1 hr. per week, both terms.

A lecture course dealing with fuels, their use, preparation, caloric value and combustion.

243. Metallurgy. G. A. Guess.
Departments 2 and 6, III Year; 1 hr. per week, both terms.
Fuels, temperature of combustion, specific heat, conductivity and problems thereon; chimneys, furnaces, refractories, outline of furnace metallurgy and hydro-metallurgy.

244. Physical Metallurgy. J. A. Newcombe.
Departments 3, 5, 6 and 7, III Year; 2 hrs. per week, second term.
A lecture course on general Physical Metallurgy.

245. Metallurgy. G. A. Guess, J. E. Toomer.
Department 8, III Year; 2 hrs. per week, first term; 1 hr. per week, second term.
A lecture course on General Metallurgy accompanied by 3 hrs. laboratory per week, first term, and 6 continuous hrs. per week, second term.

246. Physical Metallurgy. J. A. Newcombe.
Department 8, III Year; 1 hr. per week, both terms.
Changes of phase and of state, pyrometry, preparation of alloys, miscibility of metals, binary, ternary and complex alloys, the use of the microscope, with 3 hrs. laboratory per week, first term.

247. Metallurgy. G. A. Guess, J. E. Toomer.
Departments 2 and 6 (m), IV Year; 1 hr. lecture per week, both terms; 6 continuous hrs. laboratory per week, second term.
General metallurgy and metallurgical problems.

248. Metallurgy Problems. G. A. Guess, J. E. Toomer.
Department 8, IV Year; 2 hrs. lecture and 4 hrs. laboratory per week, both terms.
Metallurgical book-keeping, balance sheets, thermal balance sheets, methods and processes.

249. Metallurgy. G. A. Guess.
Department 8, IV Year; 1 hr. per week, both terms.
Critical reading and discussion of papers and articles, describing metallurgical processes or dealing with plant arrangement and construction. Metallurgical flow sheets of typical plants.

250. Physical Metallurgy. J. A. Newcombe.
Departments 6m and 8, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

251. Physical Metallurgy. J. A. Newcombe.
Department 2, IV Year; 2 hrs. lecture and 3 hrs. laboratory per week, first term.
The physical properties and structure of iron and steel and the more common alloys.

252. Physical Metallurgy. J. A. Newcombe.
Department 1, II Year; 1 hr. lecture per week, second term.
The physical properties of metals and alloys used in civil engineering practice.

253. Heat Treatment of Iron and Steel. J. A. Newcombe.
Department 3, IV Year; 1 lecture per week, both terms.
Heat treatment of iron and steel, case carburizing, case hardening and malleableizing.

CERAMICS

254*a*. Ceramics. R. J. Montgomery.
Department 8a, III Year; 4 hrs. per week, first term; 2 hrs. per week, second term.
Lectures covering origin, properties and classification of clays and other ceramic materials from a manufacturing standpoint; methods of manufacture, including preparing, shaping and burning clay ware.

254*b*. Ceramics. R. J. Montgomery.
Department 8a, III Year; 2 hrs. per week, second term.
Lectures on the composition of clear and coloured glazes.

254*c*. Ceramics. J. E. Toomer.
Department 8a, III Year; 1 hr. per week, second term.
Lectures and problems on calculations necessary for the compounding of ceramic bodies and glazes.

254*d*. Ceramics. R. J. Montgomery.
Department 8a, III Year; 9 hrs. per week, first term; 3 hrs. per week, second term.
Work on the identification and testing of clays.

254*e*. Ceramics. J. E. Toomer.
Department 8a, III Year; 6 hrs. per week, both terms.
Laboratory practice in the analysis of ceramic materials.

254*f*. Ceramics. R. J. Montgomery.
Department 8a, IV Year; 2 hrs. per week, first term.
Lectures on composition and properties of refractory material; composition of bodies made with ceramic material, with special reference to white-ware and porcelain.

254*g*. Ceramics. R. J. Montgomery.
Department 8a, IV Year; 2 hrs. per week, second term.
Lectures on the manufacture and composition of glass; manufacture and composition of iron enamels.

254*h*. Ceramics. R. J. Montgomery.
Department 8a, IV Year; 1 hr. per week, second term.
Lectures on specifications, testing and methods of testing ceramic materials.

254*i*. Ceramic Laboratory. R. J. Montgomery.
Department 8a, IV Year; 7 hrs. per week, first term; 9 hrs. per week, second term.
Advanced work on compounding and testing ceramic bodies and glazes.

MINERALOGY

255. Elementary Mineralogy. J. E. Thomson.

Departments 2, 5 and 8, I Year; 2 hrs. per week, first term.

After introducing the student to the chief chemical, physical, and crystallographic characteristics of minerals, the course becomes descriptive and deals with about one hundred of the minerals most important from the industrial or scientific point of view.

Text book: Text-book of Mineralogy—Dana.

256. Mineralogy. J. E. Thomson.

Department 6, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

Introduction to determination of minerals by inspection and physical tests.

Text book: Mineral Tables—Eakle.

257. Primary Mineralogy. A. L. Parsons.

Department 1, II Year; 2 hrs. per week, first term.

A very brief introduction to the study of minerals and rocks.

Text books: Minerals and How to Study Them—Dana. Handbook of Rocks—Kemp.

258. Mineralogy. J. E. Thomson.

Department 2, I Year; 1 hr. per week, first term; 3 hrs. per week, second term.

Determination of minerals by inspection and by means of physical tests; introduction to blow-pipe practice.

Text books: Mineral Tables—Eakle. Determinative Mineralogy—Lewis.

258*a*. Mineralogy. J. E. Thomson.

Departments 5 and 8, I Year; 1 hr. per week, first term.

Determination of minerals by inspection and by means of physical tests.

Text book: Mineral Tables—Eakle.

259. Mineralogy. A. L. Parsons, J. E. Thomson.

Department 1, II Year; 1 hr. per week, first term; 2 hrs. per week, second term.

Determination of minerals by inspection and by means of physical tests; study of common rock types and their identification.

Text books: Mineral Tables—Eakle. Handbook of Rocks—Kemp.

260. Elementary Petrography. T. L. Walker.

Department 2, II Year, and Department 5 and 8a, III Year; 1 hr. per week, both terms.

A course of lectures and laboratory work introducing the student to the microscopic study of rocks.

Text book: Handbook of Rocks—Kemp.

261. Mineralogy. J. E. Thomson.

Department 2, II Year; 2 hrs. per week, both terms.

Determination of minerals by means of the blow-pipe and physical properties.

Text books: Mineral Tables—Eakle. Determinative Mineralogy —Lewis.

262. General Petrography. A. L. Parsons.

Department 2, III Year, and Department 8a, IV Year; 1 hr. per week, both terms.

Study of the chief rock-forming minerals and of some phases of petrography not covered in the course of the previous year.

Text books: Minerals in Rock-Sections—Luquer. Petrology for Students—Harker.

263. Petrography. T. L. Walker.

Department 2, III Year, and Department 8a, IV Year; 2 hrs. per week, both terms.

Study of the chief rock-forming minerals, of rocks in thin sections and in hand specimens.

Text books: Petrology for Students—Harker. Minerals in Rock Sections—Luquer.

264. Mineralogy. T. L. Walker.

Department 5, III Year; 1 hr. lecture per week, both terms.

A lecture course on morphological crystallography.

Reference book: Crystallography—Walker.

MODERN LANGUAGES

265. German. H. Boeschenstein.

Department 6, I Year, 2 hrs. per week, both terms; II, III and IV Years, 1 hr. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

265*a*. German. C. Barnes.

Department 5, I Year; 2 hrs. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: First German Course for Science Students—Fiedler and Sandbach.

265*b*. German. C. Barnes.

Department 5, II Year; 1 hr. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: Second German Course for Science Students—Fiedler and Sandbach.

266. Spanish.

Department 6m, IV Year; 1 hr. per week, both terms.

An introduction to Spanish grammar, pronunication and practice in reading Engineering Spanish.

MUNICIPAL ENGINEERING

267. Sanitary Engineering. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. lecture per week, both terms.

267a. Sanitary Engineering. A. E. Berry, W. J. Smither.

Department $1a_1$, IV Year; 3 hrs. laboratory per week, second term.

Consideration is given to the problems of water supply, sewerage and municipal sanitation as viewed by the engineer. The lectures and laboratory work include the design of water distribution and sewer systems, as well as water and sewage treatment works. Problems are assigned from assumed data and from material secured in the field. Excursions to places of interest are also arranged from time to time.

Reference books: Public Water Supplies—Turneaure and Russell. Manual of Water Works Practice of the American Water Works Association. American Sewerage Practice—Metcalf and Eddy, 3 vols. Solving Sewage Problems—Fuller and McClintock.

268. Highway Engineering. W. L. Sagar.

Department $1a_1$, IV Year; 1 hr. lecture per week, second term, and 3 hrs. laboratory per week, second term.

This course of instruction deals with the design, construction and maintenance of highways and street pavements, and with the properties of the materials employed. The laboratory course deals with subsoils, bituminous and non-bituminous materials of construction.

Text books: Construction of Roads and Pavements—Agg. Rural Highway Pavements—Harger.

RAILWAY ENGINEERING

269. Railway Engineering. W. M. Treadgold.

Department $1a_2$, IV Year; 1 hr. per week, first term, 2 hrs. per week, second term, and 4 hrs. per week, second term, in the drafting room.

This course of lectures and practical work is intended to make the student acquainted with the general principles of railway engineering and transportation. The economic theory of location, train resistance, effect of grade distance and curvature rise and fall, maintenance of way, yards and terminals, tunnels and street railway practice; also the principles of urban and interurban transportation.

Text books and references: The Economic Theory of Railway Location—A. M. Wellington. Proceedings of the Railway Engineering Association.

269*a*. Railway Structures. C. R. Young.

Department $1a_2$, IV Year; 1 hr. lecture per week, first term; 2 hrs. laboratory per week, second term.

A course of lectures with exercises covering alternative bridge layouts with comparative estimates of costs, temporary and permanent trestles, tunnels, tunnels vs. bridges, buildings, turn-tables, snow-sheds and shelters.

SURVEYING

270. Surveying. S. R. Crerar.

Departments 1, 2, 3, 7 and 8, I Year; 1 hr. per week, both terms.

The lecture course includes the general principles; surveying with the chain, the compass and chain and the transit and chain, and level, the applications of trigonometry to inaccessible heights and distances; mensuration of surfaces, co-ordinate surveying, division of land, etc.

Text books: Plane Surveying—Tracy. Theory and Practice of Surveying—Johnson and Smith. Elementary Surveying—Breed and Hosmer.

270*a*. Surveying. T. L. Rowe.

Department 4, I Year; 1 hr. per week, first term.

The lecture course includes the general principles and practice of surveying with the chain, the transit, and the level, with special consideration given to the survey of lots and small estates.

271. Field Work. S. R. Crerar, J. W. Melson, T. L. Rowe.

Departments 1, 2, 3, 7 and 8, I Year; 6 hrs. per week, first term.

This course comprises testing chains; practice in chaining; a complete survey of a piece of land with the chain and transit; keeping of field notes; the use of the transit and compass in surveying closed figures and traverse lines and in ranging straight lines; plotting by latitudes and departures, and otherwise computing areas. Instrumental work with level, including roadway improvement.

271*a*. Field Work. T. L. Rowe.

Department 4, I Year; 3 hrs. per week, first term.

This course comprises practice in chaining, a complete chain survey of a small estate, keeping field notes, the use of the transit and level and their application in building layouts, cross section work with the level, including calculation for excavations.

272. Surveying. W. M. Treadgold.

Department 1, II Year; 1 hr. per week, both terms.

This course of lectures takes up in detail, simple, reverse and compound curves as applied to railroad and highway surveying. It also includes stadia, plane table and photographic surveying as applied to topographic work, and the main features of mine and hydrographic and aerial surveying.

Text books: Henck, Searles, Allen (Field books for Engineers) Theory and Practice of Surveying—Johnson and Smith. Surveying —Breed and Hosmer.

272*a*. Surveying. E. W. Banting.

Department 2, II Year; 1 hr. per week, both terms.

This course of lectures takes up mine surveying with problems related thereto. It also includes the simple curve as applied to railroad surveying, stadia topographical surveying, plane table and the main features of hydrographic surveying.

Text books: Surveying—Breed and Hosmer. Mine Surveying Durham.

273. Field Work. W. M. Treadgold, E. W. Banting.

Department 1, II Year; 9 hrs. per week, first term.

Department 2, II Year; 6 hrs. per week, first term.

This course of instruction embraces all adjustments of the transit and level, minor problems in triangulation and traversing, levelling and plane table practice, curves and topography.

274. Surveying. W. M. Treadgold.

Department 1, III Year; 1 hr. per week, both terms.

This course of lectures takes up the work of the railroad engineer on construction, including profiles, cross-sectioning, computation of volume of earthwork, overhaul, transition curves, laying out turnouts, frogs and switches, etc. Also a discussion of trigonometric and barometric levelling.

Text books: Field Engineering—Searles. Railroad Curves and Earthworks—Allen.

275. Survey Camp. W. M. Treadgold, S. R. Crerar, E. W. Banting, J. W. Melson.

Departments 1 and 2, III Year; Department 1b, IV Year.

The University of Toronto Survey Camp is ideally located in County of Haliburton at an elevation of 1,000 feet above sea level and comprises a tract of field, woodland and lake front property. The country is broken and rolling and with the numerous small lakes and streams in the immediate vicinity is admirably suited for work and the various problems that arise in practical surveying. Since the camp has been established, Professor Stewart has made a careful triangulation survey, establishing triangulation stations near the camp connected with primary stations of the Geodetic Survey of Canada. This triangulation has been adjusted and complete computations made. Also through the interest and co-operation of Mr. Noel Ogilvie, Director of the Geodetic Survey, permanent bench marks were established at Miner's Bay on Gull Lake, connecting up levels with the precise level net of Canada.

By rail the camp may be reached by taking the Canadian National train leaving Lindsay for Haliburton, getting off at Gelert, where conveyances are always on hand to drive to the camp, a distance of 12 miles, by way of Minden, the county town.

All mail, telegrams or telephone messages should be addressed to the "University Survey Camp, Minden, Ontario". Baggage should be checked to Minden via Gelert on the Canadian National Railway.

Each student will provide at least three pairs of heavy blankets, sheets, towels, raincoats, personal supplies, all of which should be limited to about 60 lbs., and carried in suit cases or dunnage bags.

This course includes:

(*a*) Secondary Triangulation and Base Line Measurements.
(*b*) Stadia, Plane Table and Boundary Traverses.
(*c*) Highway and Railway Location.
(*d*) Cross Sectioning and Computation of Earthwork.
(*e*) Stream Gauging and Discharge Measurements.
(*f*) Hydrographic Surveying.
(*g*) Photographic and Micrometer Work.
(*h*) Stadia and Plane Table Topography.
(*i*) Mine Surveying.
(*j*) Observations for Time, Azimuth and Latitude.
(*k*) Geological Survey.

A complete field course in Practical Astronomy and Geodesy is given to students taking this option in the Fourth Year, Department of Civil Engineering including the adjustment of a triangulation, observations for time, latitude and azimuth and base line measurements.

Students in Departments 1 and 2 will be required to take the Survey Camp between the Second and Third Year; and, on failure to do so, this subject will be carried as a supplemental in the Third Year.

PRACTICAL EXPERIENCE

276. Practical Experience.

Department 7.

Each student registered in the Department of Electrical Engineering is required to submit to the Secretary of the Faculty, not later than January 15th in each session, certificates and a detailed report regarding practical experience. Certificate forms, the nature of the report, and information regarding the kinds of experience to be sought, are available at the office of the Secretary.

PHYSICAL TRAINING

280. Physical Training. G. D. Porter.

Required in all Departments, I and II Years, and optional in the III and IV Years.

By order of the Board of Governors, each male undergraduate proceeding to a degree must take Physical Training in the first and second academic years of his course. In each session in which Physical Training is compulsory he must first undergo a medical

examination by the Director of the University Health Service, and must then register for Physical Training at the office of the Athletic Association in Hart House. Students of all years who wish to take part in any form of athletics or physical exercise, must first undergo a medical examination by the Director. Those classified as A1 may elect to take any form of competitive athletics during the season in which that form of sport is in progress.

Military training in the C.O.T.C. constitutes an option in Physical Training (see page 143).

ZYMOLOGY

283. Zymology.

Department 6z, IV Year.

A study of the phenomena of fermentation and of the mechanism of enzyme action.

THESIS

285. Thesis.

Required in all Departments, IV Year, with the exception of Department 4, Architectural Design Option. Department 3, IV Year; 1 hr. per week, both terms. For requirements in Department 2, see course 67, and in Department 6, see course 113.

Each student must prepare a thesis on a subject and in a form approved by the head of the department in which the student is registered.

ADVANCED MATHEMATICS

See Mathematics, p. 94

Elective courses in Mathematics are offered to students of the I and II Years. Students of the I Year will be informed at the beginning of the fall term whether or not they are qualified to proceed with the advanced course. Those who take this course will try the ordinary pass examination papers, plus an advanced problem paper at the end of the year. The pass standing for proceeding to the Second Year will be determined by the ordinary paper, the marks of the problem paper being used to determine whether or not the student has shown sufficient proficiency to take the advanced work of the Second Year.

Students of the Second Year taking the advanced course will try the ordinary pass examination papers plus an advanced problem paper, pass standing being determined by the ordinary papers and proficiency for further advanced work by the problem paper.

Although these courses are entirely elective, students who are qualified to take them are urged to proceed with this work.

The names of those who pass these advanced papers will be published with the regular results each year as having completed these courses.

290. Advanced Mathematics. The Staff in Mathematics.

All Departments, I year; 3 hrs. lecture per week, first term; 4 hrs. lecture per week, second term.

In addition to the regular material included under courses 236, 238, students will take work on advanced problems on conics; parametric equations on conics; curve tracing and asymptotes; circular and hyperbolic functions; expansions of functions of one variable; partial fractions; elementary theory of equations; determinants up to the third order; one-parameter families of curves and their differential equations; differential equations in elementary mechanics; curve fitting and approximate integration.

291. Advanced Mathematics. The Staff in Mathematics.

Departments 1, 3, 6, and 7, II Year; 2 hrs. lectures per week, both terms.

In addition to the regular material included under course 237, students will take work on elementary space geometry; partial differentiation; expansions of functions of more than one variable; multiple integration; ordinary differential equations of first order and first degree; linear differential equations with constant coefficients; applications to problems in mechanics.

292. Algebra and Calculus. S. Beatty.

Department 5, I Year; 3½ hrs. per week, both terms.

Polynomials and rational functions, elementary theory of equations, inequalities, determinants, limits, summation of series, binomial, exponential, and logarithmic series, expansions of the circular and hyperbolic functions and their inverses, the methods and operations of the Calculus considered intuitively and illustrated by applications, and elementary differential equations.

Text book: Introduction to the Calculus—Osgood.

293. Analytical Geometry of the Plane. S. Beatty.

Department 5, I Year; 1½ hrs. per week, both terms.

Cartesian and polar coordinates, transformation of coordinates, straight lines and curves of the second degree, projective properties of conics, the principle of duality, higher plane curves.

Text book: Analytical Geometry—Nowlan.

294. Differential Calculus. J. D. Burk.

Department 5, II Year; 3 hrs. per week, both terms.

Differentiation, Taylor's theorem and series for functions of one or more variables, families of curves and surfaces and their differential equations, Jacobians, geometrical and mechanical applications.

Text books: Introduction to the Calculus—Osgood. Differential and Integral Calculus, Vol. I—Courant.

295. Integral Calculus and Differential Equations. I. R. Pounder.

Department 5, II Year; 3 hrs. per week, both terms.

The indefinite integral, integration of rational and other special functions, the definite integral, differentiation with respect to a parameter, multiple integration, Fourier's series, geometrical and mechanical applications, approximate integration, introduction to ordinary differential equations.

Text books: Introduction to the Calculus—Osgood. Differential and Integral Calculus, Vol. 1—Courant.

296. Analytical Geometry of Space. S. Beatty.

Department 5, II Year; 1 hr. per week, both terms.

Cartesian and other systems of point coordinates, curves and surfaces and their equations in parametric or non-parametric form, data fixing planes, lines, conics, and quadrics, generating lines and circular spectrons of quadrics, classification of quadrics, tangent cones to quadrics, metric and projective properties of quadrics, families of quadrics, ruled surfaces and surfaces of revolution.

Text book: Analytic Geometry—Nowlan.

297. Differential Equations. I. R. Pounder.

Department 5, III Year; 1 hr. per week, both terms.

First order equations solvable by quadratures, depression of the order, the linear equation, systems of linear equations with constant coefficients, first order partial equations in two variables, total differential equations, particular equations of the second order.

Text books: Differential Equations—Piaggio. Differential Equations—Cohen.

298. Introduction to the Theory of Functions. S. Beatty.

Department 5, III Year; 1 hr. per week, both terms.

Green's and Stokes's Theorems, conformal mapping of one plane region on another, the complex variable, analytical functions, Cauchy's Theorem and Integral Formula, Poisson's Formula, Taylor's and Laurent's series, analytic continuation and the Schwarz reflection principle, singularities and their significance.

Text book: Theory of Functions—Rothe, Ollendorff, and Pohlhausen.

PHYSICS

301. Properties of Matter, Mechanics, and Heat. John Satterly.

Department 5, I Year; 3 hr. lecture per week and $4\frac{1}{2}$ hrs. laboratory per week, both terms.

This course involves lectures and laboratory work supplementing the work taken in the lectures. In addition to the work in the divisions indicated in the title, the course also includes lectures and problems on calculations for science students involving the use of the elementary calculus and statistics. The course is planned in

conjunction with the work taken under the title of Engineering Mechanics.

Reference books: Dynamics—Duncan and Sterling. Heat—Gray. Analytical Mechanics—Barton. Mechanics of Fluids—Barton. Properties of Matter—Wagstaff. Heat—Stewart and Satterly. Heat—Draper. Mathematical and Physical Tables—Clark. Calculus made easy—Thompson. Theory of Measurements—Tuttle and Satterly.

302. Elementary Magnetism and Electricity. L. Gilchrist.

Department 5, II Year; 1 hr. lecture per week, first term; 2 hrs. lecture per week, second term.

This course deals with the fundamental theory of magnetism and electricity, including the introduction of electron theory and alternating currents.

Reference books: Advanced Text-book of Magnetism and Electricity—Hutchinson. A treatise on Electricity—Pidduck. Electricity and Magnetism—Starling. Mathematical Physics, Vol. 1—Barlow.

303. Elementary Light. H. A. McTaggart.

Department 5, II Year; 1 hr. lecture per week, both terms.

This course deals with the fundamental theory of light, including treatment of interference, diffraction, polarized light, and the introduction of geometrical optics.

Reference books: Light for Students—Edser. Introduction to Physical Optics—Robertson. Optical Measuring Instruments—Martin.

304. Acoustics. E. F. Burton.

Department 5, II Year; 1 hr. lecture per week, first term.

This course deals with the fundamental theory of acoustics, including stationary waves and elementary treatment of architectural acoustics and sound transmission.

Reference books: Science of Musical Sounds—D. C. Miller. Speech and Hearing—Fletcher. Sound—A. B. Wood. Acoustical Engineering—West.

305. Magnetism and Electricity, Light, and Acoustics.

Department 5, II Year; 3 hrs. laboratory per week in the first term, and 6 hrs. laboratory per week in the second term.

This laboratory work is carried out under the direction of the staff in Physics and covers lectures dealt with in the above courses.

306. Mathematical Operations Applied to Physics. C. Barnes.

Department 5, III Year; 1 hr. lecture per week throughout the year.

This course involves an account of vectors illustrated by the application of vector algebra to physical problems, and an elementary treatment of such things as Fourier Series and Spherical Harmonics.

307. Theory of Potential and Electrical Measurements. E. F. Burton.

Department 5, III Year; 1 hr. lecture per week throughout the year.

This course deals with the elementary theory of potential as applied particularly to electrical and mechnaical work.

Reference books: Electricity and Magnetism—Starling. Principles of Electricity—Page and Adams.

308. Electron Tubes and High Frequency Circuits. D. S. Ainslie, A. Pitt.

Department 5, III Year; 1 hr. lecture per week throughout the year.

This course involves the fundamental theory of electron tubes together with the treatment of the various measurements involved in work with high frequency circuits.

Reference books: Electron Tubes—Williams. Principles of Radio Communication—Morecroft. Wireless Principles—Palmer.

309. Properties of Matter. John Satterly.

Department 5, III Year; 2 hrs. lecture per week throughout the year.

This course involves advanced work on properties of matter, dealing very extensively with gravity and gravitation, elasticity, viscosity, surface tension and kinetic theory of gases.

Reference books: Properties of Matter—Poynting and Thomson. General Properties of Matter—Newman and Searle. Applied Mathematics—Perry. Experimental Physics—Searle. Practical Physics—Watson. The Mechanical Properties of Fluids—Drysdale and Others.

310. Heat. John Satterly.

Department 5, III Year; 1 hr. lecture per week, first term.

This is a course in advanced heat, including thermometry (especially resistance thermometry and optical and radiation pyrometry), laws of gases, expansion, heat measurements, laws of vapours, conduction and radiation.

Reference books: Heat and Thermodynamics—Roberts. Methods of Measuring Temperature—E. Griffiths. Theory of Heat—Preston.

311. Physical Laboratory.

Department 5, III Year; 6 hrs. laboratory per week for the first term, and 3 hrs. laboratory per week for the second term.

This laboratory work includes experiments illustrating the principles involved in the four preceding courses.

312. Optics. H. A. McTaggart, K. B. Jackson.

Department 5, III Year; 1 hr. lecture and 3 hrs. laboratory work per week throughout the year.

This course deals with geometrical and physical optics and photometry as applied to optical instruments and with photography as a scientific implement.

Reference books: Optical Measuring Instruments—Martin. Photometry—Walsh.

SECTION X. EXAMINATIONS

ANNUAL

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in all subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations are 50 per cent. in the Department of Engineering Physics and 40 per cent. in all other Departments, with an average of 50 per cent. The pass marks required in the laboratory work of all Departments are 60 per cent. In the Department of Engineering Physics an average of 60 per cent. will be required in the written and practical work of the Second, Third and Fourth Years. Candidates who have attained the required average and who have failed in not more than two subjects will be required to pass supplemental examinations in those subjects to secure pass standing.

5. Honours will be granted to students who, at the annual examinations, obtain at least 50 per cent. in each written subject, at least 60 per cent in each laboratory subject, and 75 per cent. of the total number of marks allotted to the subjects of their course.

6. Honour graduate standing will be granted to those who obtain honours in the final and in one previous year.

7. Candidates who fail to secure promotion in any year will be required to take again the whole course of instruction of the year in which they fail before presenting themselves a second time for examination.

8. A student failing in the First or Second Year of the Department of Engineering Physics will not be permitted to repeat the year in this Department.

9. A student who, in either term of the session, fails to perform satisfactorily the work of his course may not be allowed to present himself at the final examinations of the year.

10. A student should submit to Council immediately after its occurrence evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day of examinations.

11. A student who has failed to complete satisfactorily the course in Physical Training prescribed for the First Year will not be permitted to register in the Third Year; and the student who has failed to complete satisfactorily the course in Physical Training prescribed for the Second Year will not be permitted to register in the Fourth Year.

12. A student will not be allowed to write any examination if he has not paid all fees and dues for which he is liable at that time.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on the 10th day of September, 1935. Notice in writing of intention to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 16th, and the fee of $10.00 received by the Bursar not later than September 1st. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements. Arrangements will be made to conduct supplemental examinations at the Survey Camp for those students in attendance at the camp.

2. If a candidate desires to write upon an annual examination as a supplemental, his application must be received by the Secretary and his fee by the Bursar, for the January examinations not later than December 1st and for the April examinations not later than March 1st.

3. Pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

CHANGE IN SCHOLARSHIP REGULATIONS

New regulations under which certain scholarships are awarded have been approved and the following is substituted for the first sub-section on page 111.

SECTION XI. SCHOLARSHIPS

Through the generosity of friends of the University, encouragement has been given to both undergraduate and graduate work in its various branches, by establishing the following scholarships, prizes, bursaries and medals.

A student will not be allowed to hold more than one of the following scholarships marked with an asterisk, but the published lists will show all those to which he would have been entitled, but for this provision. The Council may, at its discretion, award unallotted scholarships to the next eligible candidate.

Name	Years eligible	Amount	See page
*Baptie Scholarship	I	$100	111
*Harvey Aggett Memorial Scholarship	II	$75	112
*Boiler Inspection & Insurance Co. Scholarship	III	$150	112
*Jenkins Scholarship	III	$100	112
B.A.A.S. Medal	IV	....	113
Toronto Architectural Guild Medal	V	....	113
O.A.A. Scholarship	II	$100	113
Toronto Brick Company Prizes	IV	$75 & $25	113
Darling and Pearson Prize	V	$100	113
Mathers and Haldenby Prize	III	$25	113
Heating and Ventilating Engineers Prize	III, IV	$25	114
E. I. C. Prize	III	$25	114
Canadian Engineer Prize	III, IV	$50	114
*Ceramics Scholarship	III	$50	114
MacLennan-MacLeod Memorial Prize	I	$25	115
J. A. Findlay Scholarships	III, IV	....	115
Rhodes Scholarships	II, III, IV	£400	115
Ubukata Fund	All	....	117
F. W. Jarvis Bursaries	All	$50	117
U. of T. War Memorial Scholarship	All	$250	117
McCharles Prize	All & Grad.	$1,000	118
U. of T. War Memorial Fellowships	Graduate	$500	118
1851 Exhibition Science Research Scholarship	Graduate	£250	119
Nipissing Mining Co. Research Fellowship	Graduate	$1,100	121
Elizabeth Speller Memorial Fund	III, IV	....	121
Engineering Society Loan Fund	....	....	121

NOTE: On account of the continued tendency towards lower rates of interest it is possible that the value of certain scholarships or prizes at the time of payment may prove to be less than the amount stated in the calendar.

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Jenkins Scholarship	III	$100	112
B.A.A.S. Medal	IV	....	113
Toronto Architectural Guild Medal	V	....	113
O.A.A. Scholarship	II	$100	113
Toronto Brick Company Prizes	IV	$75 & $25	113
Darling and Pearson Prize	V	$100	113
Mathers and Haldenby Prize	III	$25	113
Heating and Ventilating Engineers Prize	III, IV	$25	114
E. I. C. Prize	III	$25	114
Canadian Engineer Prize	III, IV	$50	114
Ceramics Scholarship	III	$50	114
MacLennan-MacLeod Memorial Prize	I	$25	115
J. A. Findlay Scholarships	III, IV	....	115
Rhodes Scholarships	II, III, IV	£400	115
Ubukata Fund	All	....	117
F. W. Jarvis Bursaries	All	$50	117
U. of T. War Memorial Scholarship	All	$250	117
McCharles Prize	All & Grad.	$1,000	118
U. of T. War Memorial Fellowships	Graduate	$500	118
1851 Exhibition Science Research Scholarship	Graduate	£250	119
Nipissing Mining Co. Research Fellowship	Graduate	$1,100	121
Elizabeth Speller Memorial Fund	III, IV	....	121
Engineering Society Loan Fund	....	....	121

NOTE: On account of the continued tendency towards lower rates of interest it is possible that the value of certain scholarships or prizes at the time of payment may prove to be less than the amount stated in the calendar.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that from the income therefrom a scholarship of One Hundred

Dollars shall be awarded to engineering students on the record of their first year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the Annual Examinations of the First Year, enrolled in any one of the departments of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those departments. The first award was made on the results of the annual examinations of the Session 1925-26.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of Seventy-five Dollars is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a Scholarship in the Department of Mechanical Engineering of the value of One hundred and fifty Dollars to the student who obtains highest Honour Standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Bursar to the fees of the Fourth Year of the successful candidate.

JENKINS SCHOLARSHIP IN ENGINEERING

The Jenkins Scholarship in Engineering, presented by Jenkins Bros., Limited, has been donated to continue for a period of fifteen years, the first award having been made in 1925.

This annual scholarship, of the value of One Hundred Dollars, is to be awarded to the student of the Third Year registered in one of the six departments of Civil, Mining, Mechanical, Chemical, Electrical or Metallurgical Engineering, who has the highest aggregate of percentages for the First, Second and Third years.

B.A.A.S. MEDAL

A bronze medal has been donated for students of the Faculty of Applied Science and Engineering by members of the British Association for the Advancement of Science. This Medal will be awarded to the student of the Fourth Year, in any department, who, taking honours, obtains the highest aggregate percentage in practical and written examinations in the year.

TORONTO ARCHITECTURAL GUILD MEDAL

The Toronto Architectural Guild was the organization of local architects from which sprung the Ontario Association of Architects. When the new and wider association became firmly established, the Guild disbanded and handed over to a trustee board certain funds for the establishment of a medal to be awarded in the School of Architecture of the University of Toronto.

The Trustee Board, now that the fund has accumulated considerably, announces its intention of awarding this medal annually to a senior student showing outstanding ability in Architectural Design.

ONTARIO ASSOCIATION OF ARCHITECTS SCHOLARSHIP

The Ontario Association of Architects offers a scholarship of One Hundred Dollars to the student of the Second Year in the School of Architecture who at the annual examinations obtains the highest honour standing in Architectural Design, the scholarship to be awarded annually from 1928 to 1935 inclusive.

TORONTO BRICK COMPANY PRIZES

The Toronto Brick Company offers two prizes, one of Seventy-five Dollars and one of Twenty-five Dollars to those students of the Fourth Year in the School of Architecture who win first and second places in a competition arranged by the Staff in the School of Architecture for this purpose.

DARLING AND PEARSON PRIZE IN ARCHITECTURE

Messrs. Darling and Pearson, Architects, offer annually a prize of One Hundred Dollars in books to the student in the final year of the School of Architecture who is assigned the highest marks in a special problem in Architectural Design, set for this purpose by the School of Architecture. The books constituting this prize are to be selected by the successful candidate, with the approval of the School of Architecture.

The first award of this prize was made in the Session 1927-28.

MATHERS AND HALDENBY PRIZE

Messrs. Mathers and Haldenby, Architects, offer annually for five years (1933-1937 inclusive), as a prize to the student of the Third Year, School of Architecture, who is awarded the highest honour standing for

the set of measured drawings handed in at the beginning of the session as his Vacation Work, books to the value of twenty-five dollars to be selected by the donors.

HEATING AND VENTILATING ENGINEERS PRIZE

The Ontario Chapter of the American Society of Heating and Ventilating Engineers offers an annual prize of Twenty-five Dollars for a period of five years commencing 1931. The prize will be awarded to the student in either the Third or Fourth Year in the Department of Mechanical Engineering who, in the opinion of that Department, has written the most satisfactory thesis on subjects dealing with Heating and Ventilation, such thesis being prepared under special arrangement made by the Department, the result to be reported to Council at the time of the annual examination results. The thesis must be handed in not later than March 1st. The prize will not necessarily be awarded in any year.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional knowledge among its members, offers an annual prize of Twenty-five Dollars in this University, to continue for a period of five years, commencing 1931, to the student who in his Third Year in any one of the six Departments of Engineering has proved himself most deserving as disclosed by the examination results of the year in combination with his activities in the Engineering Society, or with a local branch of another recognized engineering organization.

CANADIAN ENGINEER PRIZE

An annual prize of Fifty Dollars is offered by the publishers of "The Canadian Engineer" for the best thesis submitted by a student of any Department of Engineering in the Third or Fourth Year, on a subject pertaining to highway construction, water supply, water purification, sewage disposal, hydraulic works, railway engineering, canals, harbours, structures, or foundations. Each candidate is required to obtain approval of the subject from the head of the Department in which he is registered and must submit his completed thesis to the Secretary of the Faculty not later than March 1st. The examination and grading of the theses will be carried out under arrangements made by the Faculty Council. An award will not necessarily be made in any year. The first award was made at the annual examinations, 1931.

The thesis should not be shorter than four thousand words, nor in excess of six thousand words, and may be accompanied by illustrations.

CERAMICS SCHOLARSHIP

The Canadian Ceramic Society offers an annual scholarship of the value of Fifty Dollars for a period of ten years commencing 1932, to be known as "The Ceramics Scholarship." The scholarship will be awarded

to the student in the Third Year in the Department of Metallurgical Engineering enrolled in the Ceramics Option, who has obtained the best academic standing. An award will not necessarily be made in any year.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize to the value of Twenty-five Dollars, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year Student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the Annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. In any year in which no award is made, the income from the prize for that year will be available for a second award in any subsequent year.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available to students in this Department, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award will be made to another eligible student.

RHODES SCHOLARSHIPS

A Rhodes Scholarship is tenable at the University of Oxford and may be held for three years. Since, however, the majority of Rhodes Scholars obtain standing which enables them to take a degree in two years, appointments are made for two years in the first instance, and a Rhodes Scholar who may wish to remain for a third year will be expected to present

a definite plan of study for that period satisfactory to his College and the Rhodes Trustees.

Rhodes Scholars may be allowed, if the conditions are approved by their own College and by the Oxford Secretary to the Rhodes Trustees, either to postpone their third year, returning to Oxford for it after a period of work in their own countries, or to spend their third year in postgraduate work at any University of Great Britain, and in special cases at any University on the continent of Europe, the Overseas Dominions, or in the United States, but not in the country of their origin.

The stipend of a Rhodes Scholar is fixed at £400 per year. At most Colleges, and for most men, this sum is not sufficient to meet a Rhodes Scholar's necessary expenses for term-time and vacations, and Scholars who can afford to supplement it by say £50 per year from their own resources will find it advantageous to do so.

The Rhodes Scholarship is open equally to students in all faculties. A candidate to be eligible must:

1. Be a British subject, with at least five years' domicile in Canada, and unmarried. He must have passed his nineteenth, but not have passed his twenty-fifth birthday on October 1st of the year *for* which he is elected.

2. Have reached such a stage in his course at one of the Universities of Canada that he will have completed at least two years at the University in question by October 1st of the year *for* which he is elected.

Candidates may apply either for the province in which they have their ordinary private domicile, home, or residence, or for any province in which they have received at least two years of their college education before applying. Full particulars can be obtained from Henry Borden, Esq., 320 Bay Street, Toronto 2, Secretary of the Selection Committee for the Province of Ontario.

Two scholarships may be awarded annually in the Province of Ontario if qualified candidates appear. Each candidate for a scholarship is required to make application to the Secretary of the Committee of Selection of the province in which he wishes to compete, *not later than November 10th*, using the application form to be obtained from the Secretary, and furnishing the material there specified.

3. Basis of Selection. In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments.

(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship.

(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his schoolmates.

(4) Physical vigour, as shown by interest in outdoor sports or in other ways.

Distinction, both in character and personality and in intellect, is the most important requirement for a Rhodes Scholarship. Success in being elected to office in student organizations may or may not be evidence of leadership in the true sense of the word. Mr. Rhodes evidently regarded leadership as consisting in moral courage and in interest in one's fellow men quite as much as in the more aggressive qualities. Physical vigour is an essential qualification for a Rhodes Scholarship, but athletic skill is of less importance than the moral qualities developed in playing outdoor games.

UBUKATA FUND

The S. Ubakata Fund, the gift of Mr. S. Ubakata, of the value of $10,000, provides for the establishment of prizes, medals, scholarships and loans for which Japanese students of all faculties and colleges may be eligible. Information and special application forms may be obtained from the Registrar of the University, to whom applications must be returned on or before December 1st.

F. W. JARVIS BURSARIES

Two bursaries, known as "The F. W. Jarvis Bursaries", the gift of A. H. Jarvis, Esq., of Ottawa, brother of F. W. Jarvis, of the value of $50 each, to be awarded under the following conditions:

1. These bursaries are open only to former students of Ottawa Collegiate Institute (Lisgar Street), who without some such assistance may not be able to carry on their academic courses.
2. They may be awarded at Matriculation or in any year of an undergraduate course in any Faculty of the University.
3. They shall be awarded preferably one to a man and the other to a woman student; but if in any year students of opposite sexes do not apply, both bursaries may be awarded to men or to women.
4. A bursary may be held in successive years by the same student and also in conjunction with any scholarship awarded by the University or the federated colleges.
5. The bursaries shall be awarded by the Senate of the University on the recommendation of a Committee of Award consisting of the President of the University, the Principal of Ottawa Collegiate Institute and the donor; candidates shall make application for the same not later than May 15th on the special form to be obtained from the Registrar.

UNIVERSITY OF TORONTO WAR MEMORIAL SCHOLARSHIPS

Four scholarships, each of the value of Two Hundred and Fifty Dollars, have been established by the Alumni Federation of the University from the War Memorial Fund to be awarded to students in the Faculties of Applied Science and Engineering, and Forestry.

The general basis on which scholarships may be awarded shall be as

follows: (*a*) Standing in course of studies. (*b*) Need of assistance. (*c*) Merit as shown in extra-academic activities—executive, literary, dramatic, athletic, etc. (*d*) Relationship, if any, to active service during the War.

Information regarding these scholarships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., to whom application must be made not later than April 15th.

UNIVERSITY OF TORONTO WAR MEMORIAL FELLOWSHIPS

Two Fellowships of the value of $500 each, in the School of Graduate Studies of the University have been established by the Alumni Federation of the University of Toronto from the War Memorial Fund, to be awarded to graduates of any approved university in the Dominion of Canada enrolled, or intending to enrol in the School of Graduate Studies, for the purpose of proceeding to a degree in any department of the University of Toronto. The general basis of award is as follows:

(*a*) Standing at Graduation or in previous year of postgraduate work.

(*b*) Such other general qualifications of merit as may commend themselves to the Committee, including relationship (if any) to active service during the War.

Information regarding these fellowships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., Toronto, to whom applications, accompanied by an official statement of undergraduate standing, should be made before April 15th.

The War Memorial Fellowships are accompanied by the remission of tuition fees by the University for the Session 1935-36.

MCCHARLES PRIZE

This prize was established in connection with the bequest of the late Æneas McCharles of Provincial Government bonds of the value of $10,000, and is awarded on the following terms and conditions, namely, that the interest therefrom shall be given from time to time, but not necessarily every year, like the Nobel prizes in a small way: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions, as passed by the Board of Governors, determine the method of award:—

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000.00) in money.

(3) The term "Canadian" for the purpose of this award shall mean any person Canadian born who has not renounced British allegiance; and for the purpose of the award in the first of the three cases provided for by the bequest, domicile in Canada shall be an essential condition.

(4) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(5) No prize shall be awarded for any discovery or invention unless the same shall have been proved to the satisfaction of the awarding body, to possess the special practical merit indicated by the terms of the bequest.

(6) The order of priority in which the three cases stand in the wording of the bequest shall be observed in making the award; that is, the award shall go *caeteris paribus* to the inventor of methods of smelting Canadian ores; and, failing such inventions, to the inventor of methods for lessening the dangers attendant upon the use of electricity; and only in the third event, if no inventors of sufficient merit in the field of metallurgy and electricity present themselves, to the inventor distinguished in the general field of useful scientific research.

(7) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIP

The Royal Commissioners for the Exhibition of 1851, if satisfied with the qualifications of the candidates put forward, will each year allot three Science Research Scholarships to Canada. The University of Toronto has been invited to recommend annually one or more candidates in order of merit for these scholarships.

1. Each candidate recommended must be a British subject and under twenty-six years of age, except in very special circumstances; he must be a bona fide student of Science of not less than three years' standing; he must also have completed a full University course and have spent at least one full academic year at this University ending not more than twelve months prior to the date of recommendation.

2. The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory

account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

3. Applications for these scholarships must be made to the Registrar of the University not later than April 15th; the latest date on which the recommendation of the University of Toronto for scholarships offered in 1935 can be received at the Office of the Commissioners is June 1st, 1935.

4. Each scholarship is of the value of £250 per annum, payable quarterly in advance; on presenting to the Commissioners a satisfactory final report at the expiration of his scholarship the scholar will receive a grant of £25. A scholar who is not in a position to travel at his own expense, or for whom it is not possible to obtain free passage, may make application to the Commissioners for aid towards the payment of his fare from his home to his place of study. A scholar may receive an additional annual allowance, not exceeding £30, towards the cost of University fees, if, in the opinion of the Commissioners, he is in need of such allowance.

5. The scholarship will be tenable ordinarily for two years, and in cases of exceptional merit for three years. The continuation of a scholarship for a second year will depend upon the satisfactory nature of the scholar's first year's work. Renewal for a third year will be granted only where it appears that the renewal is likely to result in work of scientific importance.

6. The scholar will be required to devote himself to research in some branch of pure or applied science, the particular nature of the work proposed to be approved by the Commissioners.

7. A scholarship may be held, with the approval of the Commissioners, at any Institution in the United Kingdom or abroad, but a scholar will not be permitted, except under very special circumstances, to conduct his investigations in the country in which he has received his scientific education.

8. Scholars will be required to furnish reports of their work at the end of each year of tenure of their scholarships.

9. Scholars will be required to devote their whole time to the objects of the scholarship, and will not be permitted to hold any position of emolument which carries with it a duty inconsistent with their obligation to the Commissioners. Scholars must in any case obtain the consent of the Commissioners before accepting any additional emoluments.

The regulations adopted by the Senate are as follows:—

The departments, students of which shall be eligible to be candidates, are:—1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geology; 13. Mineralogy; 14. Physics; 15. Physiology; 16. Zoology.

A student shall not be deemed to be ineligible because of his being on the teaching staff of the University, if he has not been in receipt of a salary of more than $800 per annum and has not been on the teaching staff for more than two years from graduation.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nomination of the candidate or candidates shall be made by a Board composed of seven members appointed by the Senate, and the Board shall consist of the Chancellor, the President, Chancellor E. W. Wallace, the Honourable Mr. Justice Masten, Dr. De Lury, Dr. C. S. MacInnes, and Dean Brett, and the Board shall have power to call to its aid as assessor any member of the teaching staff.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering to be known as The Nipissing Mining Company Research Fellowship, of the annual value of Eleven Hundred Dollars.

This Fellowship is open to the graduates of any University.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller of the class of 1893 the "Elizabeth Speller Memorial Fund" has been established, the annual income from which is available for loans to worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary.

SECTION XII. LIBRARIES AND LABORATORY EQUIPMENT

LIBRARIES

UNIVERSITY LIBRARY

The University Library is contained in a building of its own, situated on the east side of the campus that lies to the south of University College; and it maintains as well reserved book reading rooms in University College and in the Political Science Building. All students who have paid a library fee to the Bursar of the University are entitled to the privileges of the Library. Besides men's and women's reading rooms, a law reading room and a medical reading room, the building contains departmental studies, which may be used as study rooms by honour students in the various branches in which the professors hold seminary courses, and private studies, intended for members of the Faculty or advanced students engaged in research work. The Library is opened at 8.45 every morning and remains open until 10 in the evening during the academic term. Books in ordinary use may not be taken out of the building during the daytime, but are lent for the night toward 3 p.m., to be returned the following morning before 10 o'clock. Books not in general demand may, on application, be borrowed for a longer period. Failure to return a borrowed book at the proper time and other breaches of the regulations are punishable by fine or suspension from the privileges of the Library.

DEPARTMENTAL LIBRARIES

Periodicals and other literature in the University Library of special interest to the students of this faculty have been housed in the Electrical, Engineering, Mechanical and Mining Buildings for convenient reference.

These departmental libraries are situated as follows:

Applied Physics	Room 22, Engineering Bldg.
Architecture	Room 37, Engineering Bldg.
Chemical Engineering	Room 53½ Mining Bldg.
Civil Engineering	Room 25, Electrical Bldg.
	Room 22, Engineering Bldg.
Electrical Engineering	Room 25, Electrical Bldg.
Mechanical Engineering	Room 17, Mechanical Bldg.
Metallurgical Engineering	Room 37, Mining Bldg.
Mining Engineering	Room 314, Mill Bldg.

AERODYNAMIC LABORATORY

The Aerodynamic Laboratory is fully equipped with an improved 4-ft. Royal Aircraft Establishment type wind channel, aerodynamic balance, micromanometers and other necessary instruments.

Air speeds of 80 feet per second can be secured in a stream of great steadiness and uniformity and higher speeds with some sacrifice in steadiness.

The work done in the Laboratory includes the investigation of problems in aerodynamics, tests of air craft components, and complete machines, rating of meters, ventilators, radiators, etc., and the study of the effect of wind pressure on structures, chimneys, etc.

ASSAYING LABORATORIES

The Fire Assaying Laboratories are situated on the top floor of the new Mill Building. The East and West laboratories are identical and consist of preparation, furnace and balance rooms. Between and common to these is a supply room and another for the wet work in connection with the subject. The arrangement is such as to allow a natural flow of operations from preparation of the product to be assayed to the final weighing.

The preparation rooms are equipped with a Sturtevant crusher, McCool pulverizer, buck boards, samplers, cupel machines and screens. A special laboratory sampler has been constructed, for the purpose of giving samples for the students' assays, of indisputable similarity, thus confining variations in results to their work.

The furnace rooms have six Fletcher-Russell Perfected gas furnaces supported on concrete pouring tables, and two Denver Fire Clay oil-burning type. Each working table has its own balance, also a locker and drawers for fluxes, weights and tools.

The balance rooms face the north light. Protection from dust and fumes is afforded by double entrance doors. The bead balances are supported on a concrete slab resting on brick piers insulated by cork to absorb vibration. The balances are illustrative of the types met in practice, the following makers being represented—Ainsworth, Becker, Heusser, Keller, Oertling, Thompson and Voland. Some have a sensitivity of $\frac{1}{500}$ milligram.

Realizing the importance of storing fluxes, free from contamination, these are kept in an inner storeroom off the main supply room which houses clayware, and general stores. Remote from here is the ore storage room containing a large number of ores, matte, bullion and alloys, obtained chiefly from typical mining districts and metallurgical plants.

Undergraduate research is carried on in the Thesis room. This has coal and gas furnaces. Other apparatus is supplied to suit the investigations undertaken. A study room is always available.

Contiguous to the staff rooms are two equipped for research and the determinations required for instructional purposes. A Hoskins electric resistance furnace is installed, also a Leeds-Northrup controller and recorder. Other equipment includes optical, resistance and thermocouple pyrometers, microscopes, drying oven, Guess-Haultain stationary electrolytic outfit, King rotating electrolytic apparatus, and bullion rolls.

CEMENT TESTING LABORATORY

This laboratory is fitted with all the ordinary moulds, sieves, balances, burettes, steaming and drying tanks, tables, and other appliances necessary in making the usual physical tests of a Portland cement. It is also supplied with completely equipped cabinets for individual work. In addition there are the following:

A 2,000 lb. Riehlé shot machine for tension.

A 2,000 lb. Fairbanks shot machine for tension.

A 1,000 lb. Olsen automatic shot machine fitted for tests in either tension or cross breaking.

An Olsen soapstone moist closet.

CHEMICAL LABORATORIES

The Chemical Laboratories are situated in the western half of the Chemistry and Mining building, in the basement, first and second floors. The rooms are large and well lighted, and are supplied with the usual modern equipment.

Instruction in general chemistry and in elementary quantitative analysis is given in a large laboratory on the second floor, accommodating 84 students, each working place being supplied with water, gas and fume cupboard. Two adjoining laboratories, with provision for 50 students, are set aside for the use of the Second Year in the course in Chemical Engineering, while two other laboratories, with 36 and 48 working places, are used jointly by the Third Year in Chemical Engineering and by other students in Mining and Metallurgy, and also by the Department of Chemistry, Faculty of Arts. Fourth Year students in Chemical Engineering are accommodated in a laboratory which has provision for 20 men engaged in research work. Each of these laboratories has its own balance room adjoining, furnished with instruments from the best makers and adapted to the particular objects in view.

In addition there are seven small rooms set apart for research, a room for gas analysis and a specially constructed fireproof laboratory for combustion and bomb furnaces. Each of these is well equipped and offers excellent facilities for the prosecution of research, as well as for work of a technical character.

ELECTRICAL LABORATORIES

The Department of Electrical Engineering is located in the Electrical Building. The accommodation includes quarters for staff, library, lecture rooms, laboratories, stores, and shop for repairs and construction.

Services.—Three-wire direct-current, 110 kw., from the University power house, automatically regulated at our end for constant voltage of desired value at our main switchboard. Three-phase, 60 cycles, 60 k.v.a., 115 volts, automatically regulated as to voltage and frequency. Three-

phase, 25 cycles, 30 k.v.a., automatically regulated as to voltage and frequency. Every laboratory has all three services available at convenient places. There are three main boards, one for each floor. A system of special trunk lines between boards, and tree systems on each floor, enable easy arrangement of any desired special connections from any laboratory to any other.

Alternating current laboratory.—Area 26 x 110 ft., service sets 60 and 25 cycles, Tirrill regulators. Two 60-cycle and two 25-cycle, 15 k.v.a. motor-generator sets; converters: various motors, squirrel cage and wound rotor induction types, repulsion and other single-phase types, unity power factor motor, polyphase motor with variable speed shunt characteristics and speed range of 4 to 1; transformers, single and three-phase; constant-current transformers with load of series arc lamps; lamp racks, reactors, condensers, brakes, etc.; oscillographs; indicating, graphic, recording, and demand meters of the best makes; all arranged to facilitate a very general line of experimental work.

Direct current laboratory.—40 kw. 230 to 115 volt motor generator set with Tirrill regulator for special tests. Numerous 5 kw. to 10 kw. motor-generator sets; shunt, series, compound motors; special interpole machines; loading racks, dynamometers, rheostats, numerous meters of first quality, etc., for any sort of study.

Measurements Laboratory.—26 x 110 ft. Fitted with very flexible storage battery service which can be connected to any desired working place; d.c. three-wire service, also 60 and 25-cycle three-phase everywhere; galvanometers, resistance boxes, bridges, shunts, potentiometers, standard cells, bond testers, ductor, megger, apparatus for measuring low resistances, artificial lines for fault measurements, condensers, inductances, rails, cables, voltmeters, ammeters, wattmeters, dynamometers, etc., for general work on a great variety of measurements.

High voltage laboratory.—For various lines of study with voltages up to 200,000 volts. Flexible and safe provision for control.

Materials laboratories.—One specially fitted for general work on conducting materials, one for magnetic materials, one for dielectric materials.

Radio laboratory.—Adapted for the measurement of various quantities of interest in this work, including the strength of incoming signals. One single conductor aerial 1,000 ft. long, one multi-conductor aerial 120 ft. long.

Standardizing laboratories.—One students' calibration room for direct-current meters, another for alternating-current meters. A standards room, constant temperature, for master standards of voltage, resistance, current, power, etc.

Research laboratories.—Four rooms set apart for this work, in combination with facilities of the other laboratories.

Design laboratory.—Arranged for calculation work on apparatus selected to illustrate essential principles.

ELECTROCHEMICAL LABORATORIES

The Electrochemical laboratories, which are situated in the Mining Building, are provided with special facilities for electrolytic work, including a large storage battery and electroplating dynamo with tanks as well as a good set of apparatus and electrical measuring instruments. The experimental work on electric furnaces is carried out in a large furnace room in the basement, occupied jointly by this Department and the Department of Metallurgy. The equipment for this purpose comprises a 120 KW, 220 volt supply of direct current from the main power house through a switchboard, rheostats, circuit-breaker and instruments to a set of distributing bus-bars, and a 200 KV-a transformer stepping down from 2200 volts to 30-120 volts in 3 and 6 volt steps, which supplies alternating current at 25 cycles. There is a complete set of A.C. instruments, circuit-breakers, oil-switches, relays, automatic regulating winches, etc., and a Northrup high frequency furnace with its transformer is also installed.

APPLIED PHYSICS LABORATORIES

The Applied Physics laboratories, situated in the Engineering Building, are equipped as follows:

The Photometric Laboratory is equipped with precision and portable photometers for the measurement of candle-power, illumination, and brightness, integrating spheres for determining the luminous output and efficiency of lamps and lunmiaires, and colorimeters, spectro-photometers and flicker photometers for the measurement of colour. Standards of candle power, luminous flux and colour temperature are maintained and a 132 volt storage battery with all electrical controls and meters necessary for precise photometry are provided.

The Illumination Design Laboratory is equipped for demonstrating and measuring the performance of lighting installations.

The Optics Laboratory is equipped with optical benches, etc., for the testing of lenses and examples of various optical instruments for instruction in their theory and applications.

The Photographic Laboratory is equipped with cameras, darkrooms and accessories for practical work in photography, and with sensitometers, spectrographs and densitometers for the testing of photographic materials. A Zeiss phototheodolite, stereoscope, stereo-comparator and plotting apparatus are provided for instruction in photographic surveying.

The Acoustical Laboratory is equipped with the ordinary apparatus for illustrating the elementary laws of acoustics, that is, forks, pipes, conometers, etc. There are also two rooms intended for work in sound transmission and absorption. The equipment of these consists of a four octave organ for the production of sounds of constant intensity and a microphone and amplifier circuit for reception. There is also an oscillator and dynamic loud apeaker as an alternative to the organ.

The Heat and Hydrostatics Laboratory is equipped for experiments on thermometry, calorimetry, thermal expansion, heat transmission, etc., and for work with hydrometers, manometers, barometers and the determination of specific gravity.

GEOLOGICAL AND MINERALOGICAL LABORATORIES

In the Mining building on College Street the University possesses a modern laboratory for Geology and Mineralogy.

Courses are given in laboratory work, especially in personal examination of type sets of rocks, fossils, minerals and crystal models. These laboratory exercises serve to illustrate the introductory didactic instruction.

For the encouragement of pure crystallography the laboratories are supplied with goniometers of the various types, crystal models, appliances for the cutting of oriented crystal sections and for the physical examination of the same. Practical petrography is carried on in rooms provided with type sets of rocks, both macroscopic and microscopic. Advanced students are taught to make thin sections of rocks and fossils and to study them microscopically. For students in Mining a laboratory course in the interpretation of geological maps and sections is provided. Typical mining regions are studied in detail and an opportunity is afforded for the examination of specimens illustrating economic geology.

The laboratory for the preparation of thin sections of rocks, minerals and fossils is provided with electric diamond saws and grinding appliances for the various types of work incidental to the preparation of thin sections and museum material.

A room is also provided for advanced work in cartography and geological surveying.

The departments possess 40 petrological microscopes and 10 of other types, so that it is now possible to provide advanced students with instruments and sets of thin sections for their own special use. The blowpipe laboratory contains 156 lockers, especially designed for apparatus for students. Provision is made for the study of opaque minerals in reflected light.

HIGHWAY LABORATORY

ROAD METALS AND SUBGRADE SOILS

This laboratory is equipped for carrying out investigations in the various materials employed in highway construction and maintenance, and comprises the following:

A Page impact machine for testing the toughness of road materials.

A diamond core drill for preparing specimens for the toughness test.

A Deval abrasion machine for testing the resistance to wear of road materials.

A cementation testing apparatus (Page type) for determining cement in properties of road materials.

A jaw crusher (Mitchell type) for crushing rock for various tests.

A power driven agitator with sieves for the mechanical analysis of sand, gravel and crushed rock.

A Dorry hardness testing machine for determining the hardness of rock used in road construction.

A Riehlé standard brick-rattler.

A mechanical centrifuge for determining moisture equivalent of soils and apparatus for determining volumetric changes, capillary moisture and other properties of subsoils of interest to the highway engineer.

BITUMENS

This laboratory is designed for the investigation of the physical rather than the chemical properties of bitumens used in road construction and maintenance. The equipment consists of an extractor for separating bitumens and aggregates, an Engler viscosimeter, a penetration apparatus as well as appliances for determining melting point, volatilization, specific gravity, ductility, etc,

HYDRAULIC LABORATORY

The hydraulic laboratory occupies two floors each 40 feet x 112 feet, which are well lighted by large windows on the side and end.

The water for the experimental work is pumped through the various pieces of apparatus from a well by means of two turbine pumping units, both of which are driven by a Belliss and Morcom compound engine of 125 h.p. running at a speed of 525 revs. per minute. Both engine and pumps have been installed with a view to using them in experimental work as well as for supply of water for other apparatus used in the laboratory.

The pumping units are capable of delivering one cubic foot of water per second against heads of 250 feet and 300 feet respectively. These units are designed and connected up so that they may be run in series giving the above discharge at 550 feet head, or they may be run in parallel giving double the discharge at a lower head. Each pumping unit consists of two two-stage pumps mounted on a common base and driven by a single pulley, and the construction and piping are such that each two-stage pump may be driven separately or that all may be driven at once, discharging separately one cubic foot per second at about 125 feet head through each of four independent pipes, or else the pumps may be run in series or in parallel. The scheme is thus well adapted to laboratory work, and under the heads used on reaction turbines about six cubic feet per second may be obtained.

In addition to this there is an electrically driven pump capable of delivering six cubic feet per second at a head of sixty-five feet and which is most helpful in turbine testing. Attention is called to the special turbine testing flume described below.

The laboratory further contains a large vertical steel tank $5\frac{1}{2}$ feet diameter by 34 feet, with arrangements for the attachment of nozzles and other mouthpieces, etc. Connections are also arranged for reaction turbines, the tank acting as a reservoir.

The discharge from the turbines or nozzles is measured in a weir tank nearly 6 feet wide and 21 feet long, containing a contracted weir $4\frac{1}{2}$ feet wide. This weir may be calibrated by two weighing tanks, each having a capacity of about 240 cubic feet.

There are three reaction turbines and two impulse wheels all ready for experiment, the power being measured by brakes and the water by weir or orifices. Amongst the reaction turbines may be mentioned the one designed and built by Escher Wyss & Co., specially for the laboratory.

A new and specially designed turbine testing flume has recently been added to the laboratory, the machinery for which has been largely furnished through the kindness of the Dominion Engineering Works, Montreal, and Wm. Cramp and Sons, Philadelphia. This flume is supplied with water by a Moody spiral pump of twelve cubic feet per second capacity and at present there are two turbines, one of the propeller type, and also two special draft tubes and more will be added. This provides an excellent opportunity for experiment and research.

A Kaplan turbine has also been installed.

Smaller orifice and weir tanks, each about 3 x 3 x 12 feet with necessary measuring tanks, are arranged for instruction in coefficients of various kinds and practice with weirs and orifices.

A Venturi meter and other meters, also an hydraulic ram and similar devices are available for testing, and good facilities have been arranged for investigating friction and other properties of pipes and fire hose.

For special investigations on turbine and centrifugal pumps, other pumps in addition to those already described have been arranged.

The basement of the laboratory contains an open trough 5 feet wide, about 110 feet long, with a large weir at one end. It is intended to use this trough for experiments on the flow in open channels, for measurements of large discharges by means of the weir, and for experiments with current meters and Pilot tubes.

Numerous pieces of smaller apparatus, together with all instruments required, have also been provided, and the laboratory equipment is believed to be very complete. A glass trough 30 feet long has been added to the equipment.

MECHANICS OF MATERIALS LABORATORY

This laboratory is available for the scientific and commercial testing of materials of construction such as iron, steel, timber, concrete and masonry. It is supplied with the following:

A 200 ton, three-screw power testing machine, built by Riehlé Bros., Philadelphia. It will make tests in tension, compression, shear and cross-bending, and will take posts 10 feet long and beams of 16 feet in span.

A Riehlé 100 ton screw power universal testing machine, taking posts 12 feet long and beams of 18 ft. span.

A Riehlé 10-ton screw power universal testing machine.

A Riehlé 50-ton screw power universal testing machine.

A 15-ton single lever-machine, built by J. Buckton & Co., Leeds, England.

A torsion machine, built by Tinius Olsen & Co., Philadelphia, for testing the strength and elasticity of shafting. This machine will accommodate specimens up to 16 feet in length and 2 inches in diameter.

A hand power torsion machine of simple mechanical design for the testing of short shafts of a maximum diameter of one inch.

A Riehlé transverse testing machine of 5,000 pounds capacity, adapted to specimens up to 48 inches in length.

A Riehlé compressometer, with spherical seat attachment for the adjustment of specimens having slightly non-parallel faces. This compressometer will receive specimens up to 10 inches in length.

A set of Riehlé proving levers with standard weights for calibrating testing machines.

An Amsler calibrating box of 60,000 lb. capacity for calibrating testing machines.

An Olsen compression micrometer of standard type.

A 20,000 pound Olsen, hand power, wire testing machine, specially fitted for testing wooden columns with both fixed and pivoted ends.

An Olsen combined tension and cantilever type impact testing machine.

An Olsen, 20,000 pound, hand-power testing machine especially adapted for testing long columns.

An Olsen, 200 pound capacity, textile testing machine.

A Berry strain-gauge for spans of 2 inches and 8 inches and an Olsen strain gauge of the same range.

A Nalder dividing engine. This may be used either for the precise division of scales or for the calibration of instruments intended for refined measurements.

A Brinell hardness testing machine.

An Olsen Brinell proving ring, 3,000 kg. capacity, for checking the Brinell hardness tester.

A Firth hardometer with diamond and ball attachments for hardness testing.

A Shore scleroscope for testing hardness.

A Fereday-Palmer stress recorder by T. Cooke & Sons, Ltd., London.

Four Beggs deformeter gauges with necessary plugs and accessories for investigating stresses in structures by means of models.

A large number of extensometers of the usual degree of precision. These include the Bauschinger, Martens, Unwin, Ames, Riehlé, Johnson, Henning

(recording), Huggenberger and other types. In addition there are the usual scales, micrometers, telescopes and reflectors, voltmeters for the determination of metallic contact, and such other appliances as are necessary in the making of precise measurements.

The shop is equipped with a number of high-class machine tools specially fitted for reducing the specimens to the requisite shapes and dimensions with a minimum of hand labour. It is also supplied with the necessary appliances for making ordinary repairs and for making apparatus for special experiment and original investigation.

METALLURGICAL LABORATORIES

This laboratory, in the East end of the Mining Building, occupies about 3,600 sq. ft. on the basement floor and the same space immediately above on the ground floor. The basement floor is divided into one large furnace room, a small hydrometallurgical room and two store-rooms. The furnace room contains a motor driven Connersville blower, several gas fired furnaces, two small blast furnaces, and a small 6 hearth Wedge roasting furnace. The larger electric furnaces of the Department of Electrochemistry are in this room. Some are supplied with direct current, others with A.C. from a 200 K.V.A. transformer. A system of flues, with hoods over all the furnaces, leads through a Cottrell precipitator of the Rathbun type taking current at 50,000 volts, to a stack through which gases are pulled by a fan in the attic.

The hydro-metallurgical room in addition to apparatus for leaching tests contains several natural draft furnaces, a large Hoskins resistance furnace and a 113 lb. drop hammer. There are also tanks for electrolytic refining and precipitation of metals.

The upper floor is divided into laboratories, store rooms and offices. The laboratories are: 1. Metallurgical analysis; 2. Heating treatment and pyrometry; 3. Grinding, polishing and etching; 4. Metallographic room with an adjoining dark room.

In the laboratory for metallurgical analysis the student is given some training in mill and smelter methods of analysis. It is well equipped for this work.

In the heat treatment and pyrometry laboratory are a number of tube furnaces of different sizes, a Leeds & Northrup transformation point indicator with furnace, double thermocouple and twin galvanometer, a Leeds & Northrup potentiometer pyrometer, a disappearing filament pyrometer, and many thermocouples for use with galvanometer or potentiometer. For grinding and polishing there is provided two motor driven emery wheels and a set of 3 motor driven horizontal polishing plates.

The Metallographic room is equipped with the lastest type Bausch & Lomb horizontal inverted microscope type of photo micrographic apparatus, an older and horizontal photo micrographic instrument made by Pellin, Paris; two vertical photo micrographic instruments and three other metallographic microscopes.

There are also a Pellin instrument for the determination of critical points by photography according to the Saladin method, and a Leeds & Northrup type "K" precision potentiometer, which is also used for the determination of critical points.

The laboratory has a Rockwell hardness testing machine, and a wire drawing bench.

The Ceramic equipment includes:

A dry pan and a vertical pug mill.

A small dry press.

A plunger machine with tile and hollow ware dies.

An Abbé six jar ball mill.

A recuperative down draft clay testing furnace of brick construction.

An oil fired muffle decorating kiln.

A small Seger test furnace.

A high temperature oxygen acetylene furnace.

A high temperature electric muffle furnace with a temperature range up to 1700°C.

Standard screens, volumeters, elutriation apparatus driers and such sundries as are necessary for clay testing.

METROLOGICAL LABORATORY

The department of surveying and geodesy is provided with all the ordinary field instruments, such as transits, levels, compasses, micrometers, sextants, planimeters, plane tables, tapes, chains, etc., with which is carried on the instruction in practical field operations as detailed elsewhere.

A small laboratory is also established in the basement of the observatory described below, containing the necessary instruments for the refined measurements of geodetic surveying; as, a standard yard and metre, a Rogers 10-foot comparator, an invar base measuring apparatus, a Kater's pendulum with vacuum chamber, a level trier, micrometer microscopes, etc.

The geodetic observatory in connection with this department is used for the instruction of students of the Fourth Year in taking observations for time, latitude, longitude, and azimuth by the precise methods used in connection with a geodetic survey. It contains a 10-inch theodolite and zenith telescope by Troughton & Simms; an astronomical transit instrument and an 8-inch theodolite by Cooke; two electro-chronographs; a Howard astronomical clock; a Dent sideral clock; a Dent sideral break-circuit chronometer; a wireless receiving instrument; arithmometers, etc.

MINING AND ORE DRESSING LABORATORIES

During 1931 the building containing these laboratories was entirely rebuilt and greatly enlarged. The new building is 72 ft. x 100 ft., and is four storeys high with a basement under half of it. The top floor and part of the second are occupied by the assaying laboratories. The rest of the

building is given up to the ore dressing and mining laboratories, the commodious library and study rooms, lavatory and shower baths, rooms for the staff, two rooms for research in ore dressing, a model and map room and storerooms. The main ore dressing laboratory, 72 ft. x 53 ft. x 22 ft. high, is equipped with the old five stamp battery with amalgamation plates, Wilfley table, Deister Plato table, Deister slime table, an old-fashioned buddle and classifiers. Parallel with the stamp mill is a ball mill 30 in. x 24 in., which can be used alternatively with the stamps in connection with the concentrating tables. At one side of this main laboratory is apparatus representing the complete flow-sheet of a modern concentrator designed for continuous operation at the rate of 50 to 100 lbs. per hour. This plant consists of feeders, two rod mills and a ball mill each 18 in. x 12 in., with classifiers, two Wilfley tables, a Dorr type thickener, a six-cell Fahrenwald Sub A flotation unit, a conditioner, a small pilot Wilfley table, and a Genter thickener. Another laboratory, 70 ft. x 25 ft., is set aside for batch work and contains a variety of flotation machines, small ball and rod mills, apparatus for cyanide tests and for tests in magnetic concentration. Other rooms are set apart for hand screening, microscopes, balances, a chemical room and a room for roasting and other high temperature testing of ores in connection with ore dressing.

The crushing laboratory contains a Hatfield gyratory crusher, a set of rolls 16 in. x 12 in., a small Dodge crusher, two sets of miniature rolls, two disc grinders, and a dry screening machine of the Feraris type. Adjoining this room is a large room for practising sampling methods. The mining laboratory is equipped with an Ingersoll-Rand type E.R.-1 compressor and a variety of air drills representing the development of this machine, blocks of synthetic ore for practising sampling, forges for sharpening steel and moils, and shortly to be completed a laboratory for the study of ventilation problems, air conditioning, dust counts, etc. In the main basement are bins for the accommodation of a large variety of ores from the different mining districts.

MUSEUM

The ROYAL ONTARIO MUSEUM, with exhibits in Archaeology, Geology, Mineralogy, Palaeontology and Zoology, is situated at the southwest corner of Bloor Street and Queen's Park.

Students of the University in all departments are recommended to avail themselves of the privileges of the Museum, which, although under separate control, is intimately connected with the work of the University.

The Museum is open on all week days from 10 a.m. to 5 p.m., and on Sundays from 2 p.m. to 5 p.m. The admission is free to the public on Tuesday, Thursday, Saturday and Sunday. On other days an admission fee of fifteen cents is charged.

By a resolution of the Board of Trustees all regular students of the University may be admitted free on all days of the week by presenting their card of registration.

ONTARIO BOARD OF HEALTH LABORATORY

Through the courtesy of the Secretary of the Provincial Board of Health for Ontario the facilities of the excellently equipped laboratory which the Board maintains at Stanley Park have, with certain conditions, been placed at the service of the University for the investigation of problems of interest to the sanitarian and the sanitary engineer. The equipment consists of various types of sewage sedimentation tank, sewage filter, sewage measuring devices, aerators, sterilizing appliances and a complete and representative plant intended for the filtration and sterilization of water by practically all known methods.

PHOTOGRAPHIC AND PROJECTION LABORATORIES

The Photographic Laboratory contains a supply of small cameras for the use of students, enlarging cameras, printers, blue printing machine and the necessary dark rooms.

This Department also carries on a photographic and projection service for all Faculties and Departments of the University. The equipment for this work consists of cameras for making photographs up to full plate size, enlargers, photo-micrographic apparatus, motion picture cameras for both gross and micro work, with the necessary developing and printing machines, a rotary blue print machine, a photostat, etc.

For projection service there is a motion picture projector and a number of projection lanterns for service in any University Building.

THERMODYNAMICS AND MECHANICAL LABORATORY

This laboratory is included in a large, well-equipped building for the accommodation of the steam, gas, mechanical and hydraulic equipment. A more complete description of the laboratories has been published elsewhere, so that the present description is only intended to give the main features.

The part of the building set apart for thermodynamics and other mechanical work is the ground floor of a room 60 ft. x 155 ft. This room is lighted entirely from the roof in a very perfect way. A part of the space 40 ft. wide running the entire length of 155 feet is served by a 3 ton travelling crane and contains the following equipment:

50 h.p. Brown engine with separate jackets on both heads and barrel of cylinder.

Two-stage Rand air compressor having compound steam cylinders, each fitted with Meyer cut-off gear. The low pressure air cylinder has Corliss inlet gear.

30 h.p. high-speed Leonard tandem compound engine with shaft governor.

15 h.p. high-speed McEwen engine.

40 h.p. Uniflow engine.

25 h.p. General Electric steam turbine.

Two 15 h.p. Leonard engines with different types of valves, which are used for valve setting.

Centrifugal air compressor.

There are also two surface condensers with air pumps so arranged that any engine in the laboratory may be made to exhaust into the atmosphere through an open heater or into one of the condensers, the change from one arrangement to the other being accomplished in a few minutes without the aid of valves.

The laboratory further contains:

A 3 ton York refrigerating machine with tanks.

An Amsler transmission dynamometer.

Apparatus for testing injectors and steam pumps.

Hot blast heating equipment.

Numerous other pieces of apparatus and instruments.

The work on internal combustion engines and producers is performed on the following:

14 h.p. National gas engine arranged for various compressions and points of ignition.

25 h.p. horizontal Diesel engine made by Ruston and Hornsby, specially arranged for testing.

25 h.p. Allen semi-Diesel engine.

25 h.p. tractor gasoline engine.

Six cylinder Chevrolet automobile engine.

200 h.p. Sprague electric dynamometer.

Various accessories to above machines.

Steam for the laboratory is supplied by two 50 h.p. and one 100 h.p. Babcock and Wilcox boilers, the latter having an internal superheater. These boilers are located in a separate boiler room. They are used for experimental work only and are fitted up for testing. The gases pass up through two independent chimneys, and these have been arranged so that the draft and other conditions in the chimney at any point of its height may be examined.

In smaller work-rooms off the main laboratory are placed belt and oil-testing machines, apparatus for testing the efficiency of gears and machines, and for experiments in the balancing of machinery.

SECTION XIII. DISCIPLINE

1. (a) There is vested in the Council of each federated University or college, and of each faculty, disciplinary jurisdiction over and entire responsibility for the conduct of their students in respect of all matters arising or occurring in or upon their respective buildings and grounds, including residences.

(b) Disciplinary jurisdiction in all other cases as respects all students is vested in the Caput.

(c) The Students' Administrative Council, in the discharge of all duties entrusted to it, will be suported in the due discharge of those duties by the disciplinary power of the Caput.

2. No student will be allowed to continue in attendance, whose presence is deemed by the Council of his college or faculty to be prejudicial to the interests of the University.

3. Students proceeding regularly to the degree are required to attend the courses of instruction and the examinations in all subjects prescribed for students of their respective standing, and no student will be permitted to remain in the University who persistently neglects academic work.

4. Unless special permission is granted by the Council of the Faculty concerned, a student will not be permitted further registration in the University if, at the end of two sessions spent in the same year of the Faculty in which he is registered, he has failed to obtain the standing necessary to qualify him for registration in the succeeding year of the Faculty. An appeal from the decision of the Faculty Council may be made to the Senate.

5. All interference on the part of any student with the personal liberty of another by arresting him, or summoning him to appear before any tribunal of students, or otherwise subjecting him to any indignity or personal violence, is forbidden by the Caput and by the Councils of the colleges and faculties.

6. No initiation ceremony involving personal violence, personal indignity, interference with personal liberty, or destruction of property, may be held by the students of any college or faculty of the University, under the penalty of suspension or expulsion.

7. Any reception of the students of the first year in any college or faculty must be approved by the Council of that college or faculty, but such reception must not involve any infraction of the regulations of the two preceding paragraphs.

8. The organizing of a parade in the streets of the city, or the taking part in such parade without the permission of the authorities of the city on application of the Students' Administrative Council, will be regarded as a breach of discipline.

9. A student who is under suspension, or who has been expelled from a college or faculty or from the University, will not be admitted to the University buildings or grounds.

10. The constitution of every society or association of students in the Faculty of Applied Science and Engineering, and all amendments to any such constitution, must be submitted to and approved by the Council of the Faculty. All programmes of such societies or associations, must before publication, receive the sanction of the Council. Permission to invite any person not a member of a faculty of the University to preside at or address a meeting of any such society or association must be similarly obtained.

11. The name of the University is not to be used in connection with a publication of any kind without the permission of the Caput.

12. Students of any faculty or college on the premises of colleges or faculties other than those in which they are registered shall be subject to the regulations and penalties imposed by the administrative authorities of the premises concerned.

SECTION XIV. HART HOUSE

Hart House, the gift of the Massey Foundation, is so called in memory of Mr. Hart Massey. In its widest interpretation it seeks to provide for all the activities in the undergraduate's life apart from the actual work in the lecture room. It affords all the facilities of a first-rate club. In the beauty of its architecture and the various functions which it performs it is unique on this continent.

Hart House contains completely equipped club rooms, including common-rooms, reading-room, music room, debates room, sketch room, photographic dark rooms, the Great Hall, which is the students' dining-room, a small chapel, rooms reserved for religious organizations in the University, gymnasia, squash courts, swimming pool, running track, rifle-range, billiard room, library and Hart House Theatre.

Hart House is open from 8.00 a.m. to 11.00 p.m. daily and meals are served in the Great Hall throughout the academic year. Members are entitled to full privileges of all rooms in the building between these hours and the use of the gymnasia, pool, showers and locker rooms until 6.30 p.m. each day except Saturday and Sunday, subject to the regulations of the Athletic Association. On Saturday the pool together with the rest of the athletic wing closes at 4 p.m.

The Library contains a good selection of books of general interest and the reading-room a wide variety of current periodicals. These books and periodicals must not be removed from their respective rooms.

Sunday Evening Concerts are given by the leading musicians of the city at 9 p.m. in the Great Hall on certain Sundays during the session, music recitals take place at 5 p.m. every Friday in the music room, and a series of Songsters are held in that room on those Sunday evenings when there is not a concert in the Great Hall.

The Sketch Room is equipped with facilities for drawing and painting and with a collection of books on Art. A weekly sketch class is conducted by a qualified instructor and frequent exhibitions of pictures and lectures on Art are arranged.

Debates conducted on the open parliamentary system are held during the winter in the debates room. Men prominent in the public life of Canada take part from time to time in these debates.

The headquarters of the Student Christian Movement (men) are in Hart House. There is also a small chapel which is used for services and is open daily for private prayer and meditation.

A group of rooms is set apart for the use of the Faculty Union. A dining-room and a common-room are also reserved for graduate members. Six bedrooms are available at a reasonable charge for the use of guests, introduced by members.

The Warden is entrusted with the general supervision of the whole House in co-operation with the following committees: House, Hall, Library, Music, Sketch, Camera, Squash and Debates. These committees consist of two or more senior members, the Warden and a full representa-

tion of undergraduates. The undergraduates are elected annually by their fellow students. There is also a Graduate Committee. The Board of Stewards is the senior committee and has final control of the House, being directly responsible to the Board of Governors. It consists of the Warden (ex officio chairman) and representatives of the President of the University, the Board of Governors, the Faculty Union, the Athletic Association, the graduate members, the Student Christian Movement, the Men Students' Administrative Council and the undergraduate secretaries of all Standing Committees. The Comptroller, the Assistant Comptroller, the Secretary and the Assistant Secretary of Hart House are largely responsible for the administration.

All men undergraduates proceeding to a degree in the University are members of Hart House. The annual fee of $10.00 covers all fees in connection with Hart House and membership in the Athletic Association for the academic year (September to May). To prevent the use of the building by unauthorized persons every member should carry his registration card and show it on request.

Hart House has no endowment whatsoever and is entirely dependent for its upkeep on the fees received from graduates and undergraduates and from various sources of revenue in the House itself.

Occasional students are not ordinarily eligible for membership in Hart House but may make application to the Warden's office for election by the Membership Committee.

Graduates resident in Toronto and out of town graduates are entitled to the full privileges of Hart House when they have been duly elected and have paid the annual fee.

HART HOUSE THEATRE

Hart House Theatre is a Repertory Theatre existing to promote the interests of dramatic art in the widest sense. Its performances are open to members of the University and to the general public. The theatre is operated by a Board of Syndics, who are responsible to the Governors of the University for its administration. It is the policy of the Syndics to permit the rental of the theatre by those recognized dramatic societies within and outside the University which are endeavouring to do serious work.

THE SOLDIERS' TOWER

To commemorate the sacrifice of those graduates and undergraduates of our University who gave their lives in the Great War (1914-1918), the graduates have erected the Soldiers' Tower. Situated at the Southwest corner of Hart House, the Tower rises—a symbol of sacrifice—and with its screen forms a majestic link between Hart House and the old Main Building. Beneath the sheltering arches of the screen, the names of the six hundred and eighteen, to whom the memorial pays its proud and affectionate tribute, are cut deep in the stone. Above, in the belfry of the Tower, is a carillon that, as it chimes, weaves a fabric of memories for professors and students who take up the tasks laid down by those who fell.

SECTION XV. STUDENT ORGANIZATIONS

THE JOINT EXECUTIVE, STUDENTS' ADMINISTRATIVE COUNCILS

The Joint Executive, Students' Administrative Councils, is composed of the President and Head of the recognized men and women student organizations in each of the colleges, faculties and departments of the University, as outlined in Article 4 of the Constitution. The Joint Executive assumes responsibility of the publication of The Varsity, Torontonensis and the Students' Hand Book. It represents the students at University functions and on public occasions; and receives and administers all funds accruing from Student Council fees, revenues from publications and such other funds as shall become the property of the Joint Executive; and through its secretaries it organizes such inter-collegiate and University activities as may be of interest to the student body as a whole.

The annual fee paid by all undergraduates proceeding to a degree, provides for a year's subscription to "The Varsity" and entitles the student to a copy of "Torontonensis" upon graduation, and also to a copy of "The Students' Hand Book" at the beginning of each Michaelmas term. The fee also covers administrative costs of the Joint Executive.

UNIVERSITY OF TORONTO ATHLETIC ASSOCIATION

University Athletics for men are under the entire control of the University of Toronto Athletic Association, of which the executive body is the Athletic Directorate. This consists of:

- The President of the University,
- Two members of the faculty, appointed by the President,
- Two graduates, appointed by the Athletic Advisory Board,
- The Medical Director and the Financial Secretary (*ex-officio*),
- Five undergraduates, elected annually, from the student body,
- An undergraduate representative, appointed by the Men Students' Administrative Council.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with men's athletics, and no men's athletic event can be held in the University without its approval. It has full control of the athletic field, of the gymnasium, the swimming pool, and other conveniences in connection with athletics in Hart House and is empowered by the Board of Governors to make the necessary arrangements to effect the carrying out of the University regulations requiring Physical Training for men.

UNIVERSITY OF TORONTO WOMEN'S ATHLETIC ASSOCIATION

University athletics for women are under the entire control of the University of Toronto Women's Athletic Association, of which the executive body is the Women's Athletic Directorate. This consists of:

The President of the University,

Two women members of the faculty, appointed by the President,

Two women graduates, elected by the Women's Athletic Advisory Board,

The Medical Adviser for Women, the Physical Directress, and the Financial Secretary (*ex-officio*),

Five undergraduates, elected annually.

One undergraduate, appointed by the Joint Executive, Students' Administrative Councils.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with women's athletics, and no woman student may participate in any athletic event during the academic year without its permission. The Medical Adviser for Women and the Physical Directress are authorized to arrange for such Physical Training for women as is required by the University.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

The objects of the Engineering Society as set forth in its constitution are:

(*a*) The encouragement of original research in Engineering,

(*b*) The preservation of the results of such research,

(*c*) The dissemination of these results among its members,

(*d*) The cultivation of a spirit of mutual assistance and co-operation among the members of the Society in the preparation for, and in the practice of, the profession of Engineering,

(*e*) To afford an official means of communication between the Student body and the Faculty Council, the University authorities, and the students of other Faculties.

For purposes of organization the Engineering Society consists of a federation of clubs named as follows:

(*a*) The Civil Club of the Engineering Society, composed of undergraduates in Civil Engineering,

(*b*) The Mining and Metallurgical Club of the Engineering Society, composed of the undergraduates in Mining and Metallurgical Engineering,

(*c*) The Mechanical Club of the Engineering Society, composed of the undergraduates in Mechanical Engineering,

(*d*) The Electrical Club of the Engineering Society, composed of the undergraduates in Electrical Engineering,

(*e*) The Architectural Club of the Engineering Society, composed of the undergraduates in Architecture,

(*f*) The Industrial Chemical Club of the Engineering Society, composed of the undergraduates in Chemical Engineering,

(*g*) The Faculty of Applied Science Debating Club, composed of all undergraduates of the Faculty of Applied Science and Engineering.

These Clubs devote themselves to subjects of special interest to their members. Each club holds meetings at regular intervals, when papers are read, and discussions take place in technical subjects.

The Society meets during the academic years (except in April), beginning with the third Monday in October. Addresses are given by prominent men on subjects of general interest.

The Society publishes an annual, called "Transactions", which contains the addresses given at the meetings and an account of the year's activities.

A Supply Department is conducted by the Society on a co-operative plan, through which instruments, draughting supplies, stationery, and other supplies, can be purchased.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

Affiliated with the Engineering Society is the Faculty of Applied Science Athletic Association.

The Athletic Association has full control over all athletic clubs using the name of the Faculty of Applied Science. The Executive Committee has power to suspend anyone from the privileges of membership in the Association for any breach of its regulations, and controls the finances of all athletic clubs in the aforesaid Faculty. The annual membership fee of this Association is two dollars.

No other moneys are collected for the support of athletics in the Faculty of Applied Science without the sanction of the Executive Committee.

STUDENT CHRISTIAN MOVEMENT

The Student Christian Movement in the Faculty of Applied Science and Engineering is a part of the Student Christian Movement of the University, and as such, is affiliated with the Student Christian Movement of Canada and with the World Student Christian Federation. It is a fellowship, based on the conviction that in Jesus Christ are found the supreme revelation of God and the means to the full realization of life. It seeks through study, prayer and practice to understand and follow Jesus Christ and to unite in its fellowship all students who share its basic conviction as well as those who wish to test its truth.

Some of the methods employed by the Movement in realizing its purpose are study groups, forum discussions, conferences, lectures and addresses by prominent visitors, and social service in the down-town district. Many of these activities are carried on in conjunction with the S.C.M.'s of the other Colleges and Faculties.

All students who are interested in the things for which the Movement stands are cordially invited to identify themselves with it, and to share in its activities. Full information may be had from the President, whose name will be found in the Student's Hand Book, or from the Secretary of the Movement in the University, Rev. L. A. Dixon, Hart House.

UNIVERSITY OF TORONTO C.O.T.C.

The Toronto Contingent of the Canadian Officers Training Corps was organized in 1914, and is a unit of the non-permanent Active Militia. Its primary object is to provide students at Universities with a standardized measure of military training with a view to their qualifying for commissions in the country's auxiliary forces. C.O.T.C. certificates of qualification exempt their holders from examination for commissioned rank on joining a militia unit in Canada, or, if resident in the British Islands, render them eligible for commissions in the Army Reserve of Officers, the Militia, or the Territorial Army.

The facilities which are offered by the contingent for obtaining a qualification while at the University are intended to enable young gentlemen to give personal service to their country with the least possible interference with their civil careers, to ensure that units have their establishments complete in the junior commissioned ranks, and to build up an adequate reserve of scientifically trained officers who have completed a period of consecutive and systematic military training, on academic lines, of a nature calculated to produce good officers.

The contingent provides the practical work for students taking the Military Studies option for the Arts degree, as also physical exercise for students who may choose this as the form in which they will take their compulsory Physical Training. In addition to service in the corps for a University credit, students of any year or faculty are trained in it to qualify for officers' certificates in the Infantry, Artillery, Engineers, Army Medical Corps and Signallers, writing on the examinations set by the War Office for members of O.T.C. contingents throughout the Empire.

Permanent commissions in the Royal Canadian Air Force and the Permanent Forces of the Canadian Militia are open to qualified cadets of the C.O.T.C.; selected cadets may also attend summer camps of instruction in Artillery, Signalling, Small Arms and Aviation.

There are at present four companies and the training of each is so arranged that, on leaving the University, students may be qualified for commissions in that branch of the militia to which their University course particularly applied.

The present Headquarters are at 184 College Street, and include armouries, members' reading room, library, and lecture rooms.

The Contingent Staff is:

Officer Commanding..............Lieut.-Col. J. R. Cockburn, M.C., V.D.
Second in Command.........................Major H. H. Madill, V.D.

Adjutant....................................Capt. D. R. Nichol
Paymaster....................................Capt. T. A. Reed
Quartermaster................................Lt. W. E. Carswell
Medical Officer..............................Capt. D. L. MacLean
Chaplain.................................Capt. L. A. Dixon, O.B.E.
Contingent Sergeant-Major....S-M. W. Hunt, late Royal Welch Fusiliers
Company Commanders:
"A" Co.......................................Major W. S. Wilson
"B" Co..............................Capt. G. L. M. Smith, m.s.c.
"C" Co. (Applied Science)..............Major M. B. Watson, m.s.c.
"D" Co......................................Capt. F. R. Crocombe

SECTION XVI. LODGING AND BOARD

GENERAL

Accommodation is readily obtainable in numerous private boarding-houses within a short distance of the University, at a cost of from ten dollars a week upwards and board obtained separately at about seven dollars per week. A list of accredited boarding-houses is kept by the Secretary of the Students' Administrative Council in Hart House and students are recommended to consult him with reference to the selection of suitable accommodation.

UNIVERSITY RESIDENCES

By the generosity of the late E. C. Whitney, Esq., Mrs. Whitney and friends, the University offers to approximately one hundred and fifty men the advantages of residential life and excellent accommodation within its own grounds. The Residence consists of three Houses situated on the north side of Hoskin Avenue, opening upon a quadrangle, the fourth side of which is formed by Devonshire Place. They stand about two hundred yards to the north of University College and close to Hart House. The buildings are known as the South, East and North Houses.

Each House contains twenty-four single rooms and eleven suites, a suite comprising a study and two bedrooms. Two large rooms in each building, each with an open hearth, have been set aside as common rooms. A lavatory, with hot and cold shower baths, is provided for every eight men. The buildings are heated by steam and lighted by electricity.

The University supplies the table, chairs, book-case, chiffonier, bed, mattress, pillows, linen and window shades for each room; it is prepared to furnish a desk lamp for a nominal rental.

The regular rates are $3.25 a week for a single room or half of a suite. For men holding matriculation or undergraduate scholarships, and for honours men, the rates are $3.00 a week. Occupants entitled to the lower rates must when paying their rent submit to the Bursar the evidence that they have the required standing. The rent is payable as follows: For the Michaelmas Term, when the key is issued; for the Easter Term up to April 1st, at the opening of the Easter Term; for the remainder of the Easter Term, April 1st. These charges cover heat, light, house-service and house-laundry. No rent is charged for a room during the Christmas vacation unless it is occupied. For this reason the University reserves the right to use during that period any unoccupied rooms. To cover local telephone service each student in residence will be required to pay the Bursar an annual fee of $2.00. There is not separate dining hall connected with the Residence, but board may be obtained at the adjacent University Dining Hall in Hart House.

Except under very special circumstances occupants who withdraw at any time during the session will be required to pay the full rent up to April 1st.

Applications for rooms must be made in writing to the Secretary of the Residence Committee (address the Registrar's Office) and must be accompanied by a deposit of $5.00. This deposit will be returned if the application is not granted, and will be forfeited if a room is assigned to the applicant and not taken by him, unless notice of his refusal of the room is received by the Secretary in writing before September 15th. On request it will be returned in full at the end of the College year if the room key is given back and the room and furniture left in a satisfactory condition. The following principles govern the allotment of rooms: (i) A student, who, as the result of the annual spring examinations, is not assured of being able to proceed regularly to the higher year in the course in which he is enrolled will be admitted to Residence only under exceptional circumstances. Exception to this rule will be made in the case of a student who has obtained standing at the May examination, but is debarred by the rules of his Faculty from proceeding to the subsequent year until he has passed his supplemental examinations. Such a student will be assigned a room provisionally, but cannot occupy it unless he passes his Supplemental examinations in September. (ii) The rooms in each House will be distributed among the various faculties and years. (iii) A limited number of rooms will be reserved for members of the incoming First Year until September 12th. (iv) Applications will be considered in order of priority.

The University lays down three general rules, designed to prevent hazing, the use of intoxicants and gambling. The students in each House shall elect a House Committee, which is entrusted by the University with the making and enforcing of any other needed rules and with the maintenance of order. A member of the Faculty resides in each House to act as friend and adviser to the men in residence.

SUMMARY OF STUDENTS IN ATTENDANCE

SESSION 1934-35

	Graduating Departments								
Year	1	2	3	4	5	6	7	8	Total
I	9	42	30	8	12	82	24	14	221
II	11	21	39	9	..	66	40	3	189
III	21	22	47	11	..	48	37	12	198
IV	32	9	41	7	..	42	43	5	179
V	..	..	..	8	..	..	..	..	8
	73	94	157	43	12	238	144	34	795

For graduate students, see p. 150

APPENDIX. GRADUATE STUDIES

Graduates interested in pursuing courses for post-graduate degrees should send inquiries to the Secretary of the School of Graduate Studies.

AERONAUTICS

The University is equipped with a four-foot wind tunnel in a specially designed building; and, so far as the facilities permit, properly prepared graduates will be admitted for private study, or for a course leading to an advanced degree (M.A.Sc. or Ph.D.).

Graduates who wish to undertake this work should apply to the Head of the Department of Mechanical Engineering; and, if they are candidates for an advanced degree, should also register with the Secretary of the School of Graduate Studies, in accordance with the conditions laid down in the Calendar of that School.

REGULATIONS FOR DEGREES

MASTER OF APPLIED SCIENCE, MASTER OF ARCHITECTURE

The regulations governing the Degrees of Master of Applied Science (M.A.Sc.) and Master of Architecture (M.Arch.) shall be determined as follows:

1*a*. A candidate for the degree of Master of Applied Science shall hold the degree of Bachelor of Applied Science of this University or a degree from some other University recognized as equivalent by the Council of the School of Graduate Studies.

1*b*. A candidate for the degree of Master of Architecture shall hold the degree of Bachelor of Architecture or the degree of Bachelor of Applied Science in Architecture of this University or a degree from some other University recognized as equivalent by the Council of the School of Graduate Studies.

2. He shall register with the Secretary of the School of Graduate Studies at the beginning of the academic year.

3. Not later than November 1, he shall submit to the Secretary for acceptance by the Council of the School of Graduate Studies the title of his proposed thesis as approved by the department concerned.

4. Not later than May 15, he shall present evidence to the Council of the School of Graduate Studies that he has spent not less than one academic year in the department concerned as a student enrolled in one of the following departments on a course of study approved by the department: Civil Engineering, Mining Engineering, Mechanical Engineering, Architecture, Chemical Engineering, Electrical Engineering, Metallurgical Engineering.

5. Not later than May 15, evidence that the candidate has satisfactorily met all the requirements of the department with regard to thesis and to such examinations as the department shall require, shall be forwarded to the Council of the School of Graduate Studies through the sub-committee administering the regulations governing the degrees of Master of Applied Science and Master of Architecture.

CIVIL ENGINEER, MINING ENGINEER, MECHANICAL ENGINEER, ELECTRICAL ENGINEER, CHEMICAL ENGINEER, METALLURGICAL ENGINEER

The regulations governing the Professional Degrees of Civil Engineer (C.E.), Mining Engineer (M.E.), Mechanical Engineer (M.E.), Electrical Engineer (E.E.), Chemical Engineer (Chem.E.), Metallurgical Engineer (Met.E.), shall be determined as follows:

1. A candidate for one of the said degrees shall hold the diploma of the School of Practical Science or of the Faculty of Applied Science and Engineering or the degree of Bachelor of Applied Science, or shall have spent not less than two years as a member of the teaching staff in this Faculty after having graduated in Engineering from another institution of recognized reputation.

2. He shall have spent at least three years after receiving the diploma or the degree in the actual practice of the branch of engineering wherein he is a candidate for a degree.

3. Intervals of non-employment, or of employment in other branches of engineering, shall not be included in the above three years. It shall not be necessary that the several periods requisite to make up the said three years be consecutive.

4. The candidate shall obtain from the Secretary of the School of Graduate Studies, the formal application form, which, properly filled out, accompanied by the designated evidence of professional experience and by the title and synopsis of the proposed thesis, shall be delivered to the Secretary not later than the first day of November.

The evidence of professional experience shall fully describe the kind and extent of all work undertaken by the candidate since the date of graduation up to the time of application, indicating clearly the degree of responsibility for such work. Certificates from present and past employers shall accompany the application. The names and addresses of not less than five engineers to whom the candidate is personally known and who have knowledge of his professional activities shall be submitted.

5. The application, and the subject of the thesis is subject to the approval of the Board of Examiners, who may satisfy themselves by oral or written examinations in regard to the candidate's experience and competence in engineering works.

6. The candidate after notification of the approval of the Board shall prepare an original engineering thesis in the branch in which he has applied for a degree. This thesis shall be on work in which the candidate has had

actual experience and shall preferably be on the design of engineering works or processes, and shall be accompanied by all necessary descriptions, details, drawings, bills of materials, specifications, and estimates. A thesis of a solely descriptive type will not be acceptable.

7. The thesis, with accompanying papers, described in clause 6, shall be sent to the Secretary not later than the first day of March.

8. The candidate may be required to present himself for examination in the months of March or April at such time as may be arranged by the examiners.

9. The thesis, drawings, and other papers submitted under clause 7 shall become the property of the University.

10. Nothing in this statute shall prevent any candidate from receiving more than one of the said degrees, provided he has the necessary qualifications for each degree. An interval of three years must elapse between the granting of any two degrees under this statute.

DOCTOR OF PHILOSOPHY

Graduates of the Faculty of Applied Science and Engineering may proceed to the degree of Doctor of Philosophy. Information as to the conditions to be met by candidates for this degree is to be found in the Calendar of the School of Graduate Studies, which may be obtained from the Registrar of the University. The degree is an academic degree, not a professional one, and the research work and courses leading to the degree are primarily concerned with the fundamentals and underlying principles of the sciences. In general, a candidate selects one major and two minor subjects for study, the research being carried out in the major subject. A period of three years is usually required for the fulfilment of the requirements for the degree. However, it should be understood that the degree is not granted for the passing of prescribed courses or for the performance of prescribed laboratory work for a period of three years. The laboratory research work must have led to results of a high order, constituting a real contribution to the science of the major subject, and the candidate must have attained a decided maturity of knowledge and outlook before he may present himself for final examination by the Committee of the School of Graduate Studies. A graduate proposing to proceed to this degree should consult, in the first instance, with the members of the staff in the department in which he proposes to take his major subject.

A list of major and minor options in the Department of Chemical Engineering and in the Department of Mechanical Engineering are to be found in the Calendar of the School of Graduate Studies.

HIGH SCHOOL ASSISTANTS' CERTIFICATES

The Department of Education of Ontario has agreed to accept the degree of Bachelor of Applied Science as fulfilling the academic requirement for admission to the course for a High School Assistants' certificate in the Ontario College of Education.

SPECIALISTS' CERTIFICATES

By an agreement between the University of Toronto and the Department of Education of Ontario, persons holding the degree of Bachelor of Applied Science may, by taking certain prescribed courses in the Faculty of Arts, complete the academic requirements for admission to the qualifying examination for specialist courses in (*a*) Mathematics and Physics and (*b*) Science, at the Ontario College of Education. Information regarding these prescribed courses may be obtained from a pamphlet issued by the Registrar of the University, from whom copies may be had on application. Each person who desires to complete these academic requirements should communicate directly with the Registrar in order that his case may be considered and his particular conditions defined.

ONTARIO LAND SURVEYORS AND DOMINION LAND SURVEYORS

Examinations are held usually in February of each year, for the following:

Preliminary Dominion Land Surveyors
Leveller's Examination
Final Dominion Land Surveyors
Ontario Land Surveyors

Any student in this faculty is eligible for these examinations, but graduates in Civil and Mining Engineering are allowed a shortened apprenticeship before writing their final examinations. Full information respecting above examinations may be obtained from the staff in Surveying and Geodesy.

GRADUATES ENROLLED IN THE DEPARTMENTS OF THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Civil Engineering, Municipal and Structural	1
Mining Engineering	2
Mechanical Engineering	1
Architecture	1
Chemical Engineering	10
Electrical Engineering	3
Total	18

INDEX

UNIVERSITY OF TORONTO

CALENDAR

FACULTY OF APPLIED SCIENCE

AND

ENGINEERING

1936-1937

THE UNIVERSITY OF TORONTO PRESS
1936

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SECTION I. CALENDAR 1936-1937

MICHAELMAS TERM 1936

July 1 Wed....Dominion Day. Buildings closed.

July 15 Wed....Last day for receiving applications for Supplemental Examinations.

Aug. 15 Sat.....Students of the III year, Dept. 1 and 2, report at University Survey Camp.

Sept. 5 Sat.....Students of the IV year, Dept. 1, Astronomy option, report at University Survey Camp.

Sept. 7 Mon.....Labour Day. Buildings closed.

Sepr. 15 Tues....Supplemental Examinations commence.

Sept. 24 Thur....Special meeting of Faculty Council.

Sept. 28 Mon....Registration in person of the I year from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.

Students in Architecture of the II, III, and IV years report at University Survey Camp.

Sept. 29 Tues....Registration in person of the II and III years (except Architecture) from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.

The Dean's address to the I year at 9.00 a.m. in Room 38, Engineering Building.

Preliminary instruction and classification tests for the I year in Room 38, Engineering Building.

Meeting of Faculty Council.

Sept. 30 Wed....Lectures and Laboratory work commence.

Registration in person of the IV year (except Architecture), and the V year in Architecture, from 9.00 a.m. to 1.00 p.m.

The opening address by the President to the students of all faculties at 4.00 p.m. in Convocation Hall.

Oct. 1 Thur....Meeting of Faculty Council.

Oct. 3 Sat.....Stated meeting of the Caput to deal with requests as to social functions until November 15.

Oct. 7 Wed....Registration in person of II, III, and IV years in Architecture at the Faculty Office.

Oct. 9 Fri.....Meeting of Senate.

Oct. 13 Tues....First meeting of Engineering Society.

Oct. 26 Mon....Meeting of Engineering Society.

Nov. 2 Mon....Meeting of Faculty Council.

Nov. 11 Wed....Remembrance Day. Service at the Soldiers' Tower at 11.00 a.m. Neither lectures nor laboratory classes given from 10.40 a.m. to 11.20 a.m.

Nov. 12 Thur....Meeting of Engineering Society.
Nov. 13 Fri.....Meeting of Senate.
Nov. 25 Wed....Meeting of Engineering Society.
Dec. 1 Tues....Meeting of Faculty Council.
Dec. 11 Fri.....Meeting of Senate.
Meeting of Engineering Society.
Dec. 19 Sat.....Michaelmas term ends at 12.00 noon.
Dec. 25 Fri.....Christmas Day. Buildings closed.

EASTER TERM 1937

Jan. 1 Fri.....New Year's Day. Buildings closed.
Jan. 4 Mon....Easter Term begins.
Mid-session Examinations commence.
Meeting of Faculty Council.
Jan. 8 Fri.....Meeting of Senate.
Jan. 11 Mon....Meeting of Engineering Society.
Jan. 26 Tues....Meeting of Engineering Society.
Feb. 1 Mon....Meeting of Faculty Council.
Feb. 11 Thur....Meeting of Engineering Society.
Feb. 12 Fri.....Meeting of Senate.
Mar. 1 Mon....Meeting of Faculty Council.
Mar. 3 Wed....Meeting of Engineering Society.
Mar. 5 Fri.....Engineering Society Annual Elections.
Mar. 8 Mon....Engineering Society Annual General Meeting.
Mar. 12 Fri.....Meeting of Senate.
Mar. 26-29 Fri.-Mon..Easter. Neither lectures nor laboratory classes given.
Apr. 1 Thur....Meeting of Faculty Council.
Apr. 7 Wed....Easter Term ends at 5.00 p.m.
Apr. 9 Fri.....Meeting of Senate.
Apr. 13 Tues....Annual Examinations commence.
May 3 Mon....Meeting of Faculty Council.
May 14 Fri.....Meeting of Senate.
May 24 Mon....Victoria Day. Buildings closed.
June 9 Wed....Meeting of Senate.
June 10-11 Thur.-Fri..University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

1935-1936

THE UNIVERSITY

President. . THE HON. AND REV. H. J. CODY, M.A., D.D., LL.D., F.R.S.C.
Registrar. . . . . A. B. FENNELL, M.C., M.A.
Bursar. . . . . F. A. MOURÉ, MUS. DOC.
Librarian. . . . . W. S. WALLACE, M.A., F.R.S.C.
Superintendent of Buildings and Grounds. . . . . A. D. LEPAN, B.A.Sc.
Director of University Extension and Publicity. . W. J. DUNLOP, B.A., B.PAED.
Warden of Hart House. . . . . J. B. BICKERSTETH, M.C., M.A.
Director of University Health Service. . . . . G. D. PORTER, M.B.
Medical Adviser for Women Students. . MISS E. GORDON, B.A., M.B., D.P.H.
Manager of the University of Toronto Press. . . . . R. J. HAMILTON, B.A.

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean. . . . . . . C. H. MITCHELL, C.B., C.M.G., D.S.O., C.E., LL.D., D.Eng.
Secretary. . . . . W. S. WILSON, B.A.Sc., M.E.I.C.

INQUIRIES

Inquiries about admission to the Faculty of Applied Science and Engineering should be sent to the Registrar of the University.

Communications relating to curriculum, instruction and examinations, in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information about opportunities for graduates of this Faculty, reference may be made to a pamphlet issued by the Director of University Extension and Publicity entitled "Opportunities for Graduates of Applied Science and Engineering."

SECTION III. TEACHING STAFF

PROFESSORS

E. A. ALLCUT, M.Sc. (B'ham.), M.E. (Tor.), M.I.Mech.E. 48 Foxbar Rd.
Professor of Mechanical Engineering.

G. R. ANDERSON, M.A., A.M. (Har.), M.I.E.S., F.A.S.A. 7 Rose Park Cr.
Professor Emeritus of Engineering Physics and Photography.

R. W. ANGUS, B.A.Sc., M.E., M.E.I.C., M.A.S.M.E. Mechanical Bldg.
Professor of Mechanical Engineering.

E. G. R. ARDAGH, B.A.Sc., F.C.I.C., F.R.S.C. 80 Strathallan Blvd.
Professor of Applied Chemistry.

E. R. ARTHUR, B.Arch., M.A. (Liverpool), A.R.I.B.A. 163 Walmer Rd.
Professor of Architectural Design.

J. W. BAIN, B.A.Sc., F.I.C., F.R.S.C. 393 Brunswick Ave.
Professor of Chemical Engineering.

E. W. BANTING, B.A.Sc. 101 Farnham Ave.
Associate Professor of Civil Engineering: Surveying and Geodesy.

B. DE F. BAYLY, B.A.Sc. 227 Roehampton Ave.
Assistant Professor of Electrical Engineering.

M. C. BOSWELL, B.A.Sc., M.A. (Har.), Ph.D., F.R.S.C. Mining Bldg.
Professor of Organic Chemistry (in Chemical Engineering).

H. J. BURDEN, D.S.O., D.F.C., B.A.Sc., M.F.A. (Princ.)
Assistant Professor of Architecture. 26 Old Forest Hill Rd.

J. R. COCKBURN, M.C., V.D., B.A.Sc., M.E.I.C. 100 Walmer Rd.
Professor of Descriptive Geometry.

S. R. CRERAR, B.A.Sc., D.L.S. 122 Grenadier Rd.
Associate Professor of Surveying.

W. B. DUNBAR, B.A.Sc., A.M.E.I.C. 241 Glebeholme Blvd.
Assistant Professor of Engineering Drawing.

F. C. DYER, B.A.Sc., M.E.I.C. 164 Colin Ave.
Associate Professor of Mining Engineering.

G. A. GUESS, M.A. (Qu.) Oakville, Ont.
Professor of Metallurgical Engineering.

H. E. T. HAULTAIN, C.E., M.E.I.C. 156 Glencairn Ave.
Professor of Mining Engineering.

K. B. JACKSON, B.A.Sc. 362 Glengrove Ave. W.
Assistant Professor of Applied Physics.

J. T. KING, B.A.Sc. 126 Manor Rd. E.
Associate Professor of Mining Engineering.

A. T. LAING, B.A.Sc. 146 Balmoral Ave.
Associate Professor of Highway Engineering (retired).

T. R. LOUDON, B.A.Sc., M.E.I.C. 189 Sheldrake Blvd.
Professor of Applied Mechanics.

W. G. McINTOSH, B.A.Sc. 105 Bedford Rd.
Assistant Professor of Mechanical Enginering.

R. R. McLAUGHLIN, M.A.Sc., M.A., Ph.D. 52 Rosedale Rd.
Assistant Professor of Chemical Engineering.

H. H. MADILL, V.D., B.A.Sc., F.R.A.I.C. 47 Eastbourne Ave.
Professor of Architecture.

J. W. MELSON, B.A.Sc. 69 Walmsley Blvd.
Assistant Professor of Civil Engineering: Surveying and Geodesy.

R. J. MONTGOMERY, B.Sc., Cer.E. (Ohio) 7 Cottingham Rd.
Associate Professor of Ceramics.

J. A. NEWCOMBE, B.Sc. (London), A.R.S.M. 163 Mortimer Ave.
Associate Professor of Metallurgy.

H. W. PRICE, B.A.Sc. 40 Ava Rd.
Professor of Electrical Engineering.

T. R. ROSEBRUGH, M.A., F.R.S.C. 92 Walmer Rd.
Professor of Electrical Engineering.

E. A. SMITH, M.A. (McM.) Mining Bldg.
Assistant Professor of Chemical Engineering.

V. G. SMITH, B.A.Sc. 49 Nealon Ave.
Assistant Professor of Electrical Engineering.

W. J. SMITHER, B.A.Sc., M.E.I.C. 35 Wilberton Rd
Associate Professor of Structural Engineering.

L. B. STEWART, D.T.S. Whitby, Ont.
Professor Emeritus of Surveying and Geodesy.

R. TAYLOR, B.A.Sc. 82 Glen Echo Rd.
Associate Professor of Mechanical Engineering.

J. E. TOOMER, B.Sc. (N. Carolina) 152 St. George St.
Assistant Professor of Metallurgy.

W. M. TREADGOLD, B.A. 13 Woodlawn Ave. E.
Professor of Civil Engineering: Surveying and Geodesy.

C. H. C. WRIGHT, B.A.Sc., M.R.A.I.C. 419 Markham St.
Professor Emeritus of Architecture.

W. J. T. WRIGHT, M.B.E., B.A.Sc. 126 Melrose Ave.
Associate Professor of Engineering Drawing.

C. R. YOUNG, B.A.Sc., C.E., M.E.I.C. 119 Glenayr Rd.
Professor of Civil Engineering: Municipal and Structural.

A. R. ZIMMER, B.A. Sc. 80 Pine Crest Rd.
Associate Professor of Electrical Engineering.

LECTURERS

A. E. BERRY, M.A.Sc., C.E., Ph.D. 235 Gainsborough Rd.
Special Lecturer in Municipal Engineering.

R. J. BROWN, B.A.Sc. 272 Beresford Ave.
Lecturer in Electrical Engineering.

W. E. CARSWELL, B.Arch. — 419 Markham St.
Lecturer in Architecture.

T. L. CROSSLEY., A.M.E.I.C. — 28 Lonsdale Rd.
Special Lecturer in Pulp and Paper.

A. V. DELAPORTE, Chem. E., F.C.I.C. — 5 Millerson Ave.
Special Lecturer in Sanitary Engineering.

H. B. DUNINGTON-GRUBB — 4 St. Thomas St.
Special Lecturer in Architecture.

T. C. GRAHAM, B.A.Sc. — 145 St. Germain Ave.
Lecturer in Mechanical Engineering.

R. R. GRANT, O.L.S., C.A. — 58 Poplar Plains Rd.
Special Lecturer in Accountancy and Business.

G. H. HALLY, B.A.Sc. — Aurora
Lecturer in Mechanical Engineering.

P. V. JERMYN, B.A.Sc., M.E.I.C. — 109 Cluny Dr.
Lecturer in Engineering Drawing.

F. H. KIRKPATRICK, Ph.B. (Hiram) — 157 Alexandra Blvd.
Special Lecturer in Public Speaking.

R. E. LAIDLAW, B.A.Sc, K.C. — 11 Dewbourne Ave.
Special Lecturer in Engineering Law.

M. J. C. LAZIER, B.A.Sc. — Port Credit
Lecturer in Applied Mechanics.

G. R. LORD, B.A.Sc., S.M. (M.I.T.) — 5 Cottingham Rd.
Lecturer in Mechanical Engineering.

A. S. MATHERS, B.A.Sc., A.R.C.A. — 110 Highbourne Rd.
Special Lecturer in Architecture.

C. F. MORRISON, B.E. (Sask.), M.Sc. (McG.) — 394 Avenue Rd.
Lecturer in Civil Engineering: Municipal and Structural.

W. L. SAGAR, B.A.Sc., A.M.E.I.C. — 38 Melrose Ave.
Lecturer in Civil Engineering: Municipal and Structural.

J. J. SPENCE, A.M.E.I.C. — 162 Glencairn Ave.
Lecturer in Engineering Drawing.

A. WARDELL, B.A.Sc., — 124 Melrose Ave.
Lecturer in Engineering Drawing.

R. C. WIREN, B.A.Sc., A.M.E.I.C. — East House, U. of T.
Lecturer in Mechanical Engineering.

INSTRUCTORS

H. BOESCHENSTEIN, Ph.D. (Rostock) — 83 Cranbrooke Ave.
Instructor in Technical German.

C. A. BOOTH, B.A.Sc. — 161 Hopedale Ave.
Instructor in Applied Physics.

R. M. CLARK, B.A.Sc. — 44 Willcocks St.
Instructor in Engineering Drawing.

F. COATES, A.R.C.A. — Scarborough Bluffs
Instructor in Modelling.

G. R. EDWARDS, B.A.Sc. — 1263 King St. W.
Instructor in Engineering Drawing.

A. M. FITZGERALD, B.A.Sc. — 150 Summit Dr.
Instructor in Chemical Engineering.

V. L. HENDERSON, B.A.Sc. — 116 Wells St.
Instructor in Applied Physics.

C. W. JEFFERYS, R.C.A., O.S.A., LL.D.(Qu.) — 4111 Yonge St., York Mills, Ont.
Instructor in Painting.

MISS J. C. LAING, B.A. — 20 Williamson Rd.
Librarian and Instructor in Architectural History and French.

T. L. ROWE — 104 Braemore Gardens
Instructor in Civil Engineering: Surveying and Geodesy.

MACKENZIE WATERS, M.C., B.A.Sc. — 267 Roxborough St. E.
Special Instructor in Architectural Design.

S. E. WOLFE, M.A.Sc. — Streetsville
Instructor in Mining Engineering.

DEMONSTRATORS

BEAL, G. P., M. A.Sc. — 68 Lakeview Ave.
Demonstrator in Chemical Engineering.

BELL, J. W., B.A.Sc. — 20 Hurndale Ave.
Demonstrator in Electrical Engineering.

BIRSS, R. J., B.A.Sc. — North House, U. of T.
Demonstrator in Thermodynamics.

BOWMAN, W. H., B.A.Sc. — Apt. 324, 219 College St.
Demonstrator in Chemical Engineering.

BRECKENRIDGE, J. G., B.A.Sc., Ph.D. (Camb.) — 21 Cluny Ave.
Demonstrator in Chemical Engineering.

CARSWELL, J. M., B.A.Sc. — 111 Spruce Hill Rd.
Demonstrator in Engineering Drawing.

EATON, G. T., M.A. (McM.), B.Sc. (Ac.) — 32 Walmer Rd.
Demonstrator in Chemical Engineering.

EWENS, F. G., B.A.Sc. — Apt. 3, 83 Madison Ave.
Demonstrator in Thermodynamics.

FAWCETT, W. W., B.A.Sc. — 62 St. Ann's Rd.
Demonstrator in Engineering Drawing.

GALLAHER, E. G., B.A.Sc. — 16 Cedar Ave.
Demonstrator in Hydraulics.

HAMLY, D. G., M.A., Ph.D. — 106 Keewatin Ave.
Demonstrator in Applied Physics.

HELWIG, C. E., B.A.Sc. — 35a Montye Ave.
Demonstrator in Civil Engineering: Municipal and Structural.

HVILIVITZKY, J., B.A.Sc. *Demonstrator in Engineering Drawing.*	16 Harbord St.
JACKSON, W. J., M.A.Sc. *Demonstrator in Applied Physics.*	13 Glen Morris St.
JANSEN, G. V., M.A.Sc. *Demonstrator in Chemical Engineering.*	107 Avenue Rd.
JONES, L. E., B.Sc. (Man.), M.A.Sc. *Demonstrator in Hydraulics.*	East House, Knox Coll.
LAWSON, S. C. D., B.A.Sc. *Demonatrator in Machine Design.*	Eglinton Ave. E., Leaside
MACDONALD, W. C., M.A.Sc. *Demonstrator in Chemical Engineering.*	184 Glen Rd.
McGORMAN, D.G., B.A.Sc. *Demonstrator in Machine Design.*	585 Spadina Ave.
McMULLEN, W. F., B.A.Sc. *Demonstrator in Electrical Engineering.*	132 Close Ave.
MACROBIE, E.B., B.A.Sc. *Demonstrator in Thermodynamics.*	Centre House, Knox Coll.
MARTEN, H. A., B.A.Sc. *Demonstrator in Hydraulics.*	307 Lytton Blvd.
NORRIS, C. A., B.A.Sc. *Demonstrator in Electrical Engineering.*	407 Huron St.
RAPSON, W. G., M.A.Sc. *Demonstrator in Chemical Engineering.*	6 Edgewood Gdns.
RICKER, E. A., B.A.Sc. *Demonstrator in Electrical Engineering.*	53 Harbord St.
SANTO, R. E., B.A.Sc. *Demonstrator in Electrical Engineering.*	East House, U. of T.
SEGSWORTH, R. S., B.A.Sc. *Demonstrator in Thermodynamics.*	37 Woodlawn Ave. E.
SIRMAN, W. R., B.A.Sc. *Demonstrator in Hydraulics.*	606 Spadina Ave.
SUMNER, H. R., B.A.Sc. *Demonstrator in Elecirical Engineering.*	327 Lauder Ave.
WARD, M., B.A.Sc. *Demonstrator in Electrical Engineering.*	124 Bloor St. W.
WATSON, M.B., B.A.Sc. *Demonstrator in Engineering Drawing.*	121 Welland Ave.
WHALLEY, W. B., M.A.Sc. *Demonstrator in Electrical Engineering.*	81 Glenmount Park Rd.

PROFESSORS OF OTHER FACULTIES GIVING INSTRUCTION TO STUDENTS IN APPLIED SCIENCE

F. C. Auld, B.A. (McG.), M.A., B.C.L. (Ox.) 21 Poplar Plains Cres.
Professor of Roman Law and Jurisprudence and Special Lecturer in Commercial Law.

S. Beatty, M.A., Ph.D., F.R.S.C. 537 Markham St.
Professor of Mathematics.

J. D. Burk, B.A. 30 Duggan Ave.
Assistant Professor of Mathematics.

J. T. Burt-Gerrans, Phm. B., M.A., Ph.D. 46 Dewson St.
Associate Professor of Electrochemistry.

E. F. Burton, B.A. (Tor.), (Camb.), Ph.D., F.R.S.C.
Professor of Physics. 224 Queens Drive, Weston

J. B. Ferguson, B.A., F.R.S.C. 100 Albertus Ave.
Associate Professor of Chemistry.

L. Gilchrist, M.A., Ph.D. (Chic.), F.R.S.C. North House, U. of T.
Professor of Physics.

F. B. Kenrick, M.A., Ph.D. (Leip.), F.R.S.C. 77 Lonsdale Rd.
Professor of Chemistry.

A. MacLean, B.A. 488 Spadina Ave.
Professor of Geology.

W. L. Miller, B.A., Ph.D. (Munich), F.R.S.C. 8 Hawthorne Ave.
Professor of Physical Chemistry.

E. S. Moore, M.A., Ph.D. (Chic.), F.R.S.C. 18 Indian Grove
Professor of Economic Geology.

A. L. Parsons, A.B. (N.Y.) 15 Glencairn Ave.
Professor of Mineralogy.

I. R. Pounder, M.A., Ph.D. (Chic.) 19 Glen Gordon Rd.
Associate Professor of Mathematics.

D. A. F. Robinson, M.A., Ph.D. (Chic.) 592 University Ave.
Assistant Professor of Mathematics.

G. deB. Robinson, B.A., Ph.D. (Camb.) 119 Collier St.
Assistant Professor of Mathematics.

L. J. Rogers, B.A.Sc., M.A. 110 Garfield Ave.
Associate Professor of Chemistry.

J. Satterly, M.A. (Camb.), D.Sc. (Lond.), F.R.S.C. 95 Bernard Ave.
Professor of Physics.

J. E. Thomson, B.A.Sc., Ph.D. (Har.), F.R.S.C. 123 Welland Ave.
Professor of Mineralogy.

T. L. Walker, M.A. (Qu.), Ph.D. (Leip.), F.R.S.C. 20 Avondale Ave.
Professor of Mineralogy and Petrography.

SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate by statute, subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909-1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910-1911. In the session 1923-1924 the Degree of B.Arch. was offered to students in Architecture.

SECTION V. ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

GENERAL

1. Candidates for admission to the Faculty of Applied Science and Engineering must submit evidence to show that they are qualified to take one of the courses of instruction and proceed to a degree. Applicants must also submit a certificate of good character, and must have completed the seventeenth year of their age. The procedure for application and registration is described in paragraph 8 below.

2. In general, the holding of any of the following classes of certificate will constitute qualification for admission to this Faculty.

(*a*) Certificates of Ontario Pass and Honour Matriculation as described in paragraph 3 below.

(*b*) Certificates of having passed certain equivalent examinations as described in paragraph 5 below.

(*c*) Certificates of undergraduate work in other universities. See admission ad eundem statum, paragraphs 6 and 7 below.

The Senate will consider applications for the recognition of certificates other than those mentioned as occasion may require. Such certificates must be accompanied by an official statement of the marks in the various subjects upon which the certificate was granted.

ONTARIO MATRICULATION

3. Certificates of Ontario Matriculation for admission to the Faculty of Applied Science and Engineering must cover complete Pass Matriculation, and five subjects of Honour Matriculation.

PASS MATRICULATION

Complete Pass Matriculation will consist of these subjects:

English (Literature and Composition)
History (Canadian and Ancient), or Canadian History and Music,
Mathematics (Algebra and Geometry),
And three of: Greek (Authors and Accidence),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition), or
Spanish (Authors and Composition),
Science (Physics or Agriculture Part I, and Chemistry or Agriculture Part II),
Arithmetic with Mechanical Drawing* and Shop Work.*

*Credit in Mechanical Drawing and Shop Work will consist of certificates from the Principal of the School, accompanied by an approving certificate from the Director of the Technical School Branch of the Department of Education for Ontario. This option applies to students—and to such students only—who have been in attendance at, and matriculate from, a Technical School in the Province of Ontario and are so certified by the Department of Education of the Province

HONOUR MATRICULATION

Honour Matriculation will consist of these subjects:

English (Literature and Composition),
Algebra and Geometry,†
Trigonometry,†
Science (Physics and Chemistry),
And one of Greek (Authors and Composition),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition),
Spanish (Authors and Composition).

†Admission to the Department of Engineering Physics will be granted only to those who have met the regular requirements for admission to the Faculty of Applied Science and Engineering and, in addition, have obtained an average of 75 per cent. in the Mathematics (Algebra, Geometry, and Trigonometry) of the Honour Matriculation Examination. Students whose general proficiency record in other subjects is not correspondingly high are advised not to seek admission to the course.

4. Those intending to enter the course in Architecture are recommended to select French as one of the Matriculation subjects; those intending to enter Chemical, Civil, or Mechanical Engineering or Engineering Physics are recommended to select German; while those intending to enter Metallurgical Engineering are advised to select Spanish.

EQUIVALENT EXAMINATIONS

5. Certificates of the following examinations recognized as equivalent in value to the Ontario Matriculation, Pass, or Honour may be accepted as far as they meet the Ontario requirements in subjects and percentages. A candidate applying for admission on such certificates must submit an official statement of the marks upon which these certificates were awarded.

Province of Ontario
Middle School or Upper School examinations or examinations of the same standard under other names.

Province of Quebec
‡High School Leaving Certificate examination.

‡*Of Pass Matriculation standard only.*

Province of New Brunswick
Grammar School or First Class Licenses; also the Superior, except for Latin.
Province of Nova Scotia
High School Certificates of Grade XI and Grade XII issued by the Department of Education.
Province of Manitoba
Grade XI and Grade XII examinations.
Province of British Columbia
Junior (Grade XII) and Senior (Grade XIII) Matriculation examinations.
Province of Prince Edward Island
First Class License Certificates issued either by the Education Department or Prince of Wales College; Honour Diplomas issued by the above College.
Province of Alberta
Grade XI and Grade XII examinations.
Province of Saskatchewan
Grade XI and Grade XII examinations.
Newfoundland and the Maritime Provinces
Certificate of the Common Examining Board, Junior and Senior Associate Diplomas of the Department of Education of Newfoundland.
Great Britain
Certificate of having passed, or having exemption from, the Preliminary Examination of the Institution of Civil Engineers in the British Isles, or equivalent.

ADMISSION AD EUNDEM STATUM

6. An undergraduate of another university may be admitted ad eundem statum on such conditions as the Senate, on the recommendation of the Council of the Faculty, may prescribe.

7. An applicant for admission ad eundem statum must submit with his application for admission: (1) an official transcript of his record in the University from which he wishes to transfer, showing in detail the courses which he has completed with his standing in each; (2) certificate of honourable dismissal; (3) certificate of vaccination; and (4) calendar of the university giving a full description of these courses.

PROCEDURE FOR APPLICATION AND REGISTRATION

8. Candidates for admission should apply to the Registrar of the University for forms of applications for admission; they are required to fill in these forms in duplicate and return them to the Registrar *not later than* September 10th, together with the following: (*a*) all Pass and Honour

Matriculation or equivalent certificates which they may hold; (*b*) any other evidence of ability to take the work proposed; (*c*) certificate of good character; (*d*) certificate of vaccination. Failure to make early application will result in delay and inconvenience for the candidate.

9. By order of the Board of Governors, all candidates for admission must submit a certificate of successful vaccination with their application, or agree to submit such certificate within ten days after the opening of the session. The Directors of the University Health Services will arrange for the vaccination of those who so desire.

10. Students of all years are required to register in person with the Secretary of the Faculty *on the date specified on page 5 of the Calendar.*

11. Students who present themselves on subsequent days must petition the Council to be allowed to register, and Council reserves the right to reject the applications of, or impose penalties upon, those who fail to register on the date specified.

12. Every petition for registration subsequent to the prescribed day must be accompanied by a sum of money reckoned at one dollar per diem for each day thereafter. For sufficient cause the whole or part of such sum may be refunded.

SECTION VI. FEES AND DEPOSITS

1. Every student in attendance proceeding to a Bachelor's Degree in the Faculty of Applied Science and Engineering is required to pay the following annual fees: Composite, Medical Examination and Physical Training, Hart House (women exempt), Students' Administrative Councils, Engineering Society, and Athletic Association (women exempt). These fees are described in detail below.

2. Special fees are required for matriculation, supplemental examinations, admission ad eundem statum, and degrees.

3. (a) *Students must have paid fees due in the first term before proceeding to the work of the second term. A student will not be admitted to any of the University lectures or laboratory classes who is in arrears for his fees.*

(b) *A student will not be allowed to write any examination if he has not paid all fees for which he is liable at that time.*

COMPOSITE

4. (*a*) The composite fee, including tuition, library, laboratory supplies (but not laboratory deposits), and one annual examination for each year, shall be as follows:

If paid in full on or before October 15th $225.00
If paid in instalments:—
First instalment, if paid on or before October 15th 113.00
Second instalment, if paid on or before January 15th 115.00

(*b*) The composite fee is payable to the Bursar of the University. After October 15th, a deferred payment fee of $1.00 per month will be imposed until the whole amount is paid. In the case of payment by instalments, the same rule as to the deferred payment fee will apply. A student who is repeating his year is required to pay the same fee as other students.

SUPPLEMENTAL EXAMINATION

5. Candidates for supplemental examinations are required to pay a fee to the Bursar not later than September 1st. The fee for written examinations is $10.00 and for each supplemental examination in a laboratory subject requiring special supervision the fee is $20.00.

MATRICULATION, OR REGISTRATION OF MATRICULATION

6. Applicants for admission under paragraph 2, (*b*), (*c*), section V, are required to pay to the Bursar a fee of $5.00 for registration of matriculation.

ADMISSION AD EUNDEM STATUM

7. Applicants who are admitted ad eundem statum are required to pay to the Bursar a fee of $10.00.

DEGREES

8. Candidates for the degree of B.A.Sc., or B. Arch., are required to pay to the Bursar by March 15th of their year of graduation, a fee of $10.00.

MEDICAL EXAMINATION AND PHYSICAL TRAINING

9. Every man is required at the opening of each session in which Physical Training is compulsory for such student, to pay to the Bursar the annual fee of $5.00 for medical examination and such subsequent physical training as may be prescribed.

10. Every woman is required to pay a corresponding fee of $4.00.

HART HOUSE

11. Every man is required to pay to the Bursar on or before November 15th the annual fee of $10.00 for membership in Hart House. If this fee is not paid by the above date a deferred payment fee of $2.00 will be imposed.

STUDENTS' ADMINISTRATIVE COUNCILS

12. Every student is required to pay to the Bursar at the time of registration the annual fee, as shown in the summary below, paragraph 16, for the maintenace of the Students' Administrative Councils.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

13. All students in attendance are required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Engineering Society.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

14. Each man in attendance is required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Athletic Association of the Faculty.

LABORATORY DEPOSIT

15. A laboratory breakage deposit, to be paid to the Faculty at the time of registration, is required from all students. The amount of the deposit is shown in the summary below. This deposit, less charges for waste, neglect, and breakages, will be refunded by the Secretary at the end of the session. Should the deposit be insufficient to meet the charges, a levy will be made to cover the deficiency.

16. SUMMARY OF FEES AND DEPOSITS

Composite in advance	$225.00 B
In instalments	228.00 B
Supplemental Examinations*	
Written	10.00 B
Laboratory	20.00 B
Matriculation, or registration of Matriculation	5.00 B
Degrees (B.A.Sc., B.Arch), payable March 15th	10.00 B
Medical Examination and Physical Training* (men)	5.00 B
Medical Examination and Physical Training* (women)	4.00 B
Hart House (women exempt)	10.00 B
Students' Administrative Councils,	
First, Second and Third Years	2.00 B
Fourth Year	6.00 B
Engineering Society	2.00 F
Athletic Association (women exempt)	2.00 F
Laboratory Deposit, Civil, Mechanical and Electrical Engineering, Architecture and Engineering Physics	3.00 F
Mining, Chemical and Metallurgical Engineering	8.00 F

Items marked "B" are payable at the office of the Bursar; items marked "F" are payable at the Faculty Office at the time of registration.

All cheques must be made payable to "University of Toronto."

*17. Every student who has neglected to complete satisfactorily the course in Physical Training of the First or Second Year, and who must take this work during a later year, will be required to pay to the Bursar at the opening of that session a supplemental fee of $10.00 in addition to the prescribed Medical Examination fee.

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating department, or school in which he intends to proceed to a degree. There are seven departments in Engineering and the School of Architecture from which the selection may be made; viz.,

Civil Engineering (Dept. 1),
Mining Engineering (Dept. 2),
Mechanical Engineering (Dept. 3),
Architecture (Dept. 4),
Engineering Physics (Dept. 5),
Chemical Engineering and Applied Chemistry (Dept. 6),
Electrical Engineering (Dept. 7),
Metallurgical Engineering (Dept. 8).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the courses in Engineering; and Bachelor of Architecture, to those who complete the course in Architecture.

3. The courses in Engineering extend over four academic years; the course in Architecture extends over five. A student must pass in the work of each academic year before proceeding to the work of the next. See p. 124, para. 3.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 21st, 1936.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction in Engineering and Architecture are given in Sec. IX, p. 24.

7. Examinations are conducted as explained in Sec. X, p. 124.

8. Students in Mining and Mechanical Engineering, Architecture, and Electrical Engineering are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. See Sec. IX, p. 29, 33, 36, 101, 102 and 113.

9. Graduates in Engineering and Architecture may proceed to post graduate and professional degrees. The post graduate degrees include M. Arch., M.A.Sc., Ph.D.; and the professional degrees, C.E., Chem. E., E.E., M.E. (Mechanical Engineer), M.E. (Mining Engineer), and Met. E. The courses for these degrees are under the direction of the School of Graduate Studies, and candidates should send their inquiries to the Secretary of the School of Graduate Studies. Some of the requirements of these courses are given in an appendix to this Calendar.

SECTION VIII. SCHOOL OF ENGINEERING RESEARCH

THE SCHOOL

A School of Engineering Research, within the Faculty of Applied Science and Engineering, was established in the Spring of 1917 at the suggestion of the late Dean Ellis.

The School is under the direct supervision of a Committee of Management composed of fifteen members of the Faculty Council. To this Committee of the Council is entrusted the selection of researches to be undertaken under the auspices of the School, and the disposition of funds for conducting them.

The School was organized chiefly for the training of graduates in methods of research, and for the carrying out of investigations. These latter may be problems relating to specific industries or raw materials and having a specific end in view, or general problems having to do with fundamental principles.

RESEARCH ASSISTANTS

A number of research assistants in the School of Engineering Research are appointed annually on salary in the various departments of the Faculty to carry on the work of research under direction of members of the staff. This work is accepted as partial fulfilment of the requirements for the degrees of M.A.Sc.,M.Arch. and Ph.D. These research assistants are usually recent graduates, and are chosen from among those who have displayed special capacity for investigation in their undergraduate courses. Applicants should consult with members of the staff as soon as possible after the April examinations.

The facilities of the School are also open to graduates who desire to penetrate more deeply into particular phases of experimental work, or to undertake investigations either suggested by members of the staff or arising from their own work since graduation.

INQUIRIES

All communications should be sent to the secretary, Professor M. C. Boswell, Ph.D.

SECTION IX. CURRICULUM

The courses of instruction are designed to give the student a thorough grounding in the fundamentals of engineering or architecture; and, in addition, sufficient familiarity with the practical application of the principles to make him useful upon graduation. The courses are very similar in the First Year with the exception of those of Architecture, Engineering Physics and Chemical Engineering. In the succeeding years specialization develops to some extent with provision in the Third and Fourth years for optional courses in some of the graduating departments.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As the future engineer is vitally concerned with the development of the country, it is essential that he be instructed in the rudiments of economics, administration, and business, which, with his scientific training, will enable him to increase his usefulness to the full.

In some graduating departments, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful training in methods of research. In this way the undergraduate course is linked with the graduate courses, and with the work of the School of Engineering Research (page 23).

As part of the laboratory instruction, excursions to places of technical interest, both in Toronto and elsewhere, are arranged by the staff. These excursions are treated as laboratory periods with the same requirements as to attendance and reports. The total transportation costs in any one year will probably not exceed ten dollars.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The program and regulations regarding the courses of study and examinations, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course, to the conditions here laid down.

Communications relating to curricula, instruction and examinations, in the Faculty of Applied Science and Engineering, should be sent to the Secretary of the Faculty.

DEPARTMENT OF CIVIL ENGINEERING
(DEPT. 1)

The course in Civil Engineering has been so designed as to be broad and comprehensive, with a view to meeting not only the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire a technical training of such a basic character as to enable them to enter various other fields of technical employment. Concurrent with the instruction in engineering subjects, sufficient attention is given to economic, legal and administrative matters to make the graduate in this Department fitted to enter not only upon such work as Municipal Engineering, Sanitary Engineering, Highway Engineering, Railway Engineering, Geodetic Surveying, Structural Engineering and Hydraulic Engineering, but also upon administrative and executive work in both engineering and industrial undertakings.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 105.

FIRST YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus...............	236	2	–	2	–
Applied Physics............	187	1	3	1	3
Business..................	121	–	–	1	–
Descriptive Geometry.......	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity................	135	2	–	2	–
Engineering Drawing........	166	–	10	–	17
General Chemistry..........	84	2	–	1	–
Physical Training..........	280	–	2	–	2
Statics....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English..........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus..................	237	2	–	2	–
Chemical Laboratory........	89	–	–	–	6
Descriptive Geometry........	162	1	–	1	–
Economics and Finance......	123	1	–	1	–
Electricity.................	143, 144a	1	3	1	–
Elementary Astronomy......	71	1	–	1	–
Engineering Drawing........	169	–	5	–	10
Engineering Chemistry.......	93	1	–	–	–
Geology..................	195	–	–	2	–
Inorganic Chemistry.........	87a	1	–	–	–
Least Squares..............	240	–	–	1	–
Mechanics of Materials......	4	2	–	2	–
Mineralogy................	257, 259	2	1	–	2
Organic Chemistry..........	95	–	–	1	–
Physical Metallurgy.........	252	–	–	1	–
Physical Training...........	280	–	2	–	2
Public Speaking............	133	–	–	1	–
Spherical Trigonometry......	239	1	–	–	–
Surveying.................	272, 273	1	9	1	–

THIRD YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Elasticity...........	10a	1	–	1	–
Astronomy and Geodesy.....	72, 73	2	2	2	–
Cements and Concrete.......	11	1	–	1	–
Descriptive Geometry........	164	1	–	–	–
Engineering Chemistry.......	102	1	–	1	–
Engineering Drawing........	173	–	13	–	14
Engineering Geology.........	197	1	–	1	–
Hydraulics................	205, 206	2	–	2	3

THIRD YEAR SUBJECTS DEPT. 1—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Machinery	229	1	–	1	3
Mechanics of Materials Lab.	9	–	5	–	–
Stress Graphics	10	1	–	1	–
Survey Camp	275	–	–	–	–
Surveying	274	1	–	1	–
Theory of Structures	6	2	–	2	–
Thermodynamics	223, 224	1	–	1	2

FOURTH YEAR SUBJECTS DEPT. 1 (a) GENERAL OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Contracts and Specifications	127	–	–	1	–
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Foundations	14	1	–	1	–
Hydraulics	211	1	3	1	–
Management	128	1	–	–	–
Mechanics of Materials Lab.	13	–	3	–	3
Miscellaneous Structures	19	–	–	1	–
Reinforced Concrete	15	1	–	1	–
Structural Design	17, 18	2	–	1	–
Structural Design Drawing	178	–	15	–	15
Theory of Structures	12	2	–	2	–
Thesis	285	–	3	–	–
And *one* of the following Elective Groups:					
(1) Highway Engineering	268	–	–	1	3
(1) Municipal Administration	131	–	–	1	–
(1) Sanitary Engineering	267, 267a	1	–	1	3
(1) Soil Mechanics	14a	1	–	–	–
(2) Railway Engineering	269	1	–	2	4
(2) Railway Structures	269a	1	–	–	2
(2) Soil Mechanics	14a	1	–	–	–
(3) Photographic Surveying	189	3	3	2	3

FOURTH YEAR SUBJECTS DEPT. 1 (b) ASTRONOMY OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Astronomy	74, 76	2	23	2	–
Contracts and Specifications	127	–	–	1	–
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Geodesy	75, 76	2	–	2	23
Management	128	1	–	–	–
Photographic Surveying	189a	1	2	1	2
Survey Camp	275	–	–	–	–
Thesis	285	–	3	–	–

DEPARTMENT OF MINING ENGINEERING
(DEPT. 2)

The course in Mining Engineering, which originated in 1878 as a course in Assaying and Mining Geology, is intended to serve as a preliminary training for those who expect to practise in some branch of Mining Engineering, such as exploration of mining areas and primary development, mine surveying, mining processes involving civil, mechanical and electric work of underground workings, mining machinery and operation; milling and treatment of ores, assaying and other forms of analysis and research, and administrative work in both engineering and industrial undertakings.

A candidate for the degree in the Department of Mining Engineering will be required to present satisfactory evidence of having had at least six months' practical experience in work connected with mining, metallurgy or geology, for which he must have received regular wages.

The time may be spent in geological survey, in ore dressing, smelter, or lixiviation works, in an assay office in the vicinity of mining or metallurgical works, in prospecting, or on any work in or about a mine other than as an office man, or clerk. Prospecting will only count one-half (*e.g.*, four months' prospecting will be counted as two months) and must not be submitted for more than three of the six months. Not more than three months on geological surveys or in assaying will be accepted as part of the six months.

It is important to note that this experience may be put in before the student is admitted to the University.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 105.

First Year Subjects Dept. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry. and....	238	1	–	2	–
Calculus................	236	2	–	2	–
Business....................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Drawing........	166	–	9	–	12
General Chemistry..........	84	2	–	1	–
Mineralogy................	255, 258	2	1	–	3
Mining Laboratory..........	50	–	–	–	3
Physical Training...........	280	–	2	–	2
Problems and Seminar.......		–	3	–	3
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

Second Year Subjects Dept. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	89, 90	–	6	–	6
Descriptive Geometry........	162	1	–	1	–
Dyn. and Struct. Geology....	198	1	–	–	–
Economics and Finance......	123	1	–	1	–
Electricity..................	143	1	–	1	–
Elementary Petrography.....	260	1	–	1	–
Engineering Drawing........	169	–	3	–	10
Geology....................	195	–	–	2	–
Inorganic Chemistry.........	87a	1	–	–	–
Inorganic Chemistry.........	87b	–	–	1	–
Mechanics of Materials......	4	2	–	2	–

SECOND YEAR SUBJECTS DEPT. 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Metallurgy	241	–	–	1	–
Mineralogy	261	–	2	–	2
Mining	51, 53	1	3	–	–
Physical Training	280	–	2	–	2
Problems and Seminar		–	3	–	3
Steam Engines	216	1	–	–	–
Surveying	272a, 273	1	6	1	–
Theory of Measurements	65	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88, 99	1	6	1	3
Assaying	45, 46	1	3	–	3
Economic Geology	202, 203	1	–	3	2
Engineering Chemistry	102	1	–	1	–
Engineering Drawing	174	–	6	–	3
Geological Field Work	193	–	–	–	–
Hydraulics	205, 206	2	–	2	3
Introductory Research	66	–	3	–	–
Metallurgy	243	1	–	1	–
Mining	54	1	–	1	–
Ore Dressing	58, 59	1	–	1	6
Petrography	262, 263	1	2	1	2
Physics of Ore Dressing	64	1	–	1	–
Problems and Seminar		–	3	–	3
Survey Camp	275	–	–	–	–
Theory of Structures	7	1	–	1	–
Vacation Work	69	–	–	–	–

FOURTH YEAR SUBJECTS DEPT 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	47, 48	–	–	1	3
Electrical Laboratory	144a	–	3	–	–
Engineering Economics	125	–	–	1	–
Geology, Mining	200	–	–	2	–
Geology, Pleistocene and Physiographic	194, 201	1	1	1	–
Geology, Precambrian	199	2	–	–	–
Machine Design	234	1	–	1	3
Mechanics of Materials Lab.	9	–	–	–	3
Metallurgy	247	1	–	1	6
Mine Cost-Finding and Management	56	1	–	1	–
Mining	55	1	–	1	–
Ore Dressing	60, 61	1	6	1	–
Physical Metallurgy	251	2	3	–	–
Problems and Seminar		–	3	–	3
Thermodynamics	223, 224	1	3	1	–
Thesis	67	–	7	–	9
Vacation Work	70	–	–	–	–

DEPARTMENT OF MECHANICAL ENGINEERING
(DEPT. 3)

The mechanical engineer is concerned with the production and the use of power, and it is part of his work to design and manufacture suitable machinery for this purpose, and to instal and operate it. The Diesel engine and the steam turbine are the products of his effort, and he applies these prime movers to automobiles, aeroplanes, locomotives and other purposes. His work also includes the design of water turbines, and their use in hydro-electric systems.

Other branches of his work are the making of designs for air compressors, machine tools, pumps, refrigerating machines and their application to storage warehouses and ice-making, heating and ventilating equipment, materials-handling and conveying plants, and generally all mechanical work. General industrial and administrative problems are considered.

An effort is being made to help qualified students interested in the design of aeroplanes and high speed trains and cars, without laying undue stress on such work. Courses of lectures are provided and in the final year some laboratory work in the wind tunnel is available.

The following course of study has been devised to equip men for this service.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 105.

SHOP WORK

Every student registered in the Department of Mechanical Engineering is required to spend 1200 hours in mechanical work satisfactory to the Department. Half of this work must be done before the student commences his Third Year Annual Examinations in April, and the balance before he commences his Fourth Year Annual Examinations in April. The details in this regard are outlined in the Calendar under subjects 227a and 227b.

All or any part of this shop work may be completed before the student enters the University, and he is urged to complete all of it at as early a date in his course as possible.

Failure to meet the specified requirements within the time set will result in a failure in shop work, which will be dealt with similarly to a failure in any laboratory subject.

Certificate forms for this work may be obtained from the Secretary of the Faculty or from the Department.

FIRST YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus	236	2	–	2	–
Applied Physics	185a	1	3	1	3
Business	121	–	–	1	–
Descriptive Geometry	160	1	–	1	–
Dynamics	2	2	–	2	–
Electricity	135	2	–	2	–
Engineering Drawing	166	–	9	–	15
General Chemistry	84	2	–	1	–
Machines and Processes	228	1	–	1	–
Physical Training	280	–	2	–	2
Properties of Fluids	213	1	–	1	–
Statics	1	2	–	2	–
Surveying	270, 271	1	6	1	–
Technical English	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or	291	2	–	2	–
Calculus	237	2	–	2	–
Chemical Laboratory	89	–	–	–	6
Descriptive Geometry	162	1	–	1	–
Dynamics	3	1	–	1	–
Economics and Finance	123	1	–	1	–
Electricity	136, 137	2	3	2	3
Engineering Chemistry	93	1	–	–	–
Engineering Drawing	170	–	14	–	6½
Hydrostatics	212	–	–	1	–
Inorganic Chemistry	87a	1	–	–	–
Machines and Processes	228a	1	–	1	–
Mechanics of Materials	4, 9	2	–	2	3
Metallurgy	241	–	–	1	–
Organic Chemistry	95	–	–	1	–
Physical Training	280	–	2	–	2
Properties of Fluids	214	1	–	1	–
Steam Engines	216	1	–	1	–
Theory of Mechanism	230	2	1½	2	1½

THIRD YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Electrical Laboratory	140	–	4½	–	3
Engineering Chemistry	102	1	–	1	–
Engineering Drawing	177	–	6	–	3
Heat Engines	218	2	–	2	–
Hydraulics	205, 206	2	–	2	3
Machine Design	233	2	9	2	8
Magnetism and Electricity	138	1	–	1	–
Mechanics of Machinery	231	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Shop Work	227a	–	–	–	–
Theory of Structures	7	1	–	1	–
Thermodynamics	217, 219	2	3	2	3

FOURTH YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Engineering Economics	125	–	–	1	–
Heat Treatment of Iron and Steel	253	1	–	1	–
Hydraulics	207, 208, 209	3	9	3	6
Industrial Management	130	1	–	1	–
Reinforced Concrete	20	1	–	–	–
Machine Design	235	2	6	2	9
Shop Work	227b	–	–	–	–
Structural Design	17, 18, 180	2	3	–	–
Thermodynamics	220, 221, 222	3	6	3	9
Thesis	285	–	1	–	1

SHOP WORK

Attention is directed to the note on shop work on page 33.

SCHOOL OF ARCHITECTURE

(DEPT. 4)

The School of Architecture was established as a Department of the Faculty of Applied Science and Engineering in 1890 and is one of the oldest schools in the British Empire. The School is fortunate in enjoying a close connection with the Ontario Association of Architects and the Royal Architectural Institute of Canada, both of which organizations offer prizes and scholarships for competition in the School. Constant touch is kept between students and architects by lectures given fortnightly by prominent practitioners.

The School is one of a limited number in the Empire recognized by the Royal Institute of British Architects, which admits graduates to Associate Membership on application, without examination. The student is required to spend twelve months in the offices of recognized architects. This very important practical work is done in the long summer vacations and satisfactory evidence of its completion must be submitted before the granting of a degree. The Ontario Association of Architects, through its Registration Board, accepts the degree in Architecture coupled with the office practice requirement as qualification to practise the profession of Architecture in the Province of Ontario. As a matter of fact, however, few graduates commence practice without a continuation of their practical training, either here or abroad. Travel in Europe is managed by most, even with slender means, and their ability to sketch and photograph buildings, in both of which subjects they have had a thorough grounding in the University, does much to enrich their own cultural experience, and, indirectly, the architecture of the Province in which they will ultimately live. Art subjects closely related to architecture, such as modelling, water colour drawing, etc., take their proper place in the course and are described in the following pages. An event in the academic year is the period spent at Gull Lake, a University Camp, where a week is spent under supervision and instruction sketching out of doors.

Broadly speaking, the course is arranged to lay a foundation for the subsequent life of the graduate. A very considerable portion of the course is devoted to architectural design, and a student graduating should have a thorough knowledge of the principles of this important subject. He should have formed a taste and developed an appreciation of the allied arts, which should make him a valuable member of any community.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 105.

FIRST YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus...............	236	2	–	2	-
Architectural Design.........	31	–	12	–	14
Building Construction.......	37	–	–	1	–
Descriptive Geometry........	161	1	–	1	–
Elements of Arch. Form......	28	1	–	1	–
Engineering Drawing........	167	–	4	–	4
Field Work..................	271a	–	3	–	–
Freehand Drawing..........	35	–	2	–	2
French....................	44	2	–	2	–
History of Architecture......	25	1	–	1	–
Physical Training...........	280	–	2	–	2
Statics....................	1	2	–	2	–
Surveying	270a	1	–	–	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Design.........	31a	–	15	–	15
Descriptive Geometry........	163	1	–	1	–
Economics and Finance......	123	1	–	1	–
Engineering Drawing........	171	–	3	–	3
English....................	122b	1	–	1	–
Freehand Drawing and Water Colour................	35a	–	2	–	2
French....................	44a	2	–	2	–
History of Architecture......	25a	1	–	1	–
Mechanics of Materials.......	5	2	–	2	–
Modelling..................	36	–	2	–	2
Photography...............	188	1	3	1	3
Physical Training...........	280	–	2	–	2
Theory of Arch. Planning....	32	1	–	1	–
Vacation Work..............	41	–	–	–	–

Third Year Subjects Dept. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Composition....	33	1	–	1	–
Architectural Design.........	31b	1	20	–	20
Commercial Law............	124	1	–	1	–
Freehand Drawing and Water Colour................	35b	–	2	–	2
French....................	44b	1	–	1	–
Functional Requirements of Buildings..............	26	1	–	1	–
Garden Design.............	27	1	–	–	–
History of Architecture......	25b	1	–	–	–
History of Architecture	25c	–	–	1	–
Light and Sound............	190	1	2	1	2
Modelling..................	36a	–	2	–	2
Public Speaking............	133	1	–	–	–
Structural Design...........	8	1	3	1	3
Vacation Work.............	42	–	–	–	–

Fourth Year Subjects Dept. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Acoustics and Illumination Design.................	191	1	1	1	1
Building Materials..........	38	1	–	1	–
Building Stones.............	204	1	–	–	–
Contracts and Specifications ..	127	–	–	1	–
Freehand Drawing from Life..	35c	–	2	–	2
Functional Requirements of Buildings..............	26	1	–	1	–
Garden Design.............	27a	1	–	–	–
History of Fine Art..........	30	1	–	1	–
Modelling..................	36b	–	2	–	2
Sanitary Science............	39	1	–	1	–
Structural Design...........	16	1	3	1	3
Vacation Work..............	43	–	–	–	–
and either					
Architectural Design, *or*......	31c	1	21	1	21
Architectural Engineering....	31e	1	21	1	21

FIFTH YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Arch. Aspects of Town Planning	34	–	–	1	–
Architectural Economics	40a	1	–	1	–
Building Stones	204	1	–	–	–
Heating and Air Conditioning.	40	1	–	1	–
Professional Practice.........	39a	1	–	1	–
Structural Design...........	21	1	3	1	3
Water Colour and Life Drawing.....................	35d	2	–	2	–
and either					
Architectural Design, *or*......	31d	2	26	2	26
Architectural Engineering....	31f	2	28	2	28

DEPARTMENT OF ENGINEERING PHYSICS
(DEPT. 5)

Admission to this course is granted only to students who meet the special requirements set forth on page 16 of this Calendar.

The course is designed to afford a training in Mathematics and Physics beyond that which it is possible to give in the other undergraduate courses in engineering. It is believed that a wider and more thorough acquaintance with the basic sciences will bring to the student a readier appreciation of the nature of the technical problems with which he will later be confronted and a greater facility in the solution of them. A course of the kind offered should consequently be of particular value to those who desire to enter governmental or industrial research laboratories, or who wish to engage in any original work of investigation or development in the field of applied physics.

Throughout the four years of the course an effort is made to maintain the practical point of view in the theoretical instruction. This is effected, in part, by adopting wherever possible the engineering viewpoint in the teaching of mathematical and scientific subjects, and, in part, by the inclusion of certain basic engineering instruction.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Algebra and Calculus, 292, page 115.

FIRST YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Algebra and Calculus	292	3½	–	3½	–
Analytical Geometry	293	1½	–	1½	–
Descriptive Geometry	160	1	–	1	–
Electricity	135	2	–	2	–
Engineering Drawing	184	–	3	–	6
Engineering Mechanics	5a	2	–	2	–
General Chemistry	85, 86	2	3	1	3
German	265a	2	–	2	–
Mineralogy	255, 258a	2	1	–	–
Physical Training	280	–	2	–	2
Properties of Matter, Mechanics and Heat	301	3	4½	3	4½

SECOND YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Geometry of Space	296	1	–	1	–
Descriptive Geometry........	162	1	–	1	–
Differential Calculus..........	294	2	–	2	–
Electricity..................	136, 137	2	3	2	–
Elementary Acoustics.........	304	1	–	–	–
Elementary Light............	303	1	–	1	–
Elementary Machine Design...	234a	1	3	1	3
Elementary Magnetism and Electricity..............	302	2	–	1	–
Engineering Chemistry.......	93	1	–	–	–
German.....................	265b	1	–	1	–
Integral Calculus and Differential Equations...........	295	3	–	3	–
Magnetism, Electricity, Light, and Acoustics............	305	–	3	–	6
Mechanics of Materials.......	4, 9	2	–	2	3
Physical Chemistry...........	98	2	–	2	–
Physical Training............	280	–	2	–	2

Students in the Department of Engineering Physics are required to state at the beginning of the Third Year the options that they desire to pursue in the Third and Fourth Years. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give the work.

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per weel			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Engineering Mechanics	5b	1	–	1	–
Differential Equations	297	1	–	1	–
Introduction to the Theory of Functions	298	1	–	1	–
Magnetism and Electricity	138	2	–	1	–
Mathematical Operations Applied to Physics	306	1	–	1	–
Physical Laboratory	311	–	6	–	3
Properties of Matter	309	2	–	2	–
Theoretical Mechanics	331	1	–	1	–

And *one* of the following options which must be continued in the Fourth Year.

Options 5c, Electricity and Communications					
Alternating Current	139	1	–	2	–
Electrical Design	141	1	–	1	–
Electrical Laboratory	140	–	6	–	6
Heat	310	1	–	1	–
Optics	312	1	3	1	3
Physical Metallurgy	244	–	–	2	–
Theory of Potential and Electrical Measurements	307	1	–	1	–
Thermionic Tubes	150	1	–	1	3
Option 5s, X-rays and Spectroscopy					
Alternating Current	139	1	–	2	–
Electrical Laboratory	140	–	6	–	6
Electron Tubes and High Frequency Circuits	308	1	–	1	–
Heat	310	1	–	1	–
Mineralogy	264	1	–	1	–
Optics	312	1	3	1	3
Organic Chemistry	110a	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Theory of Potential and Electrical Measurements	307	1	–	1	–

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5g, Geophysics					
Alternating Current..........	139	1	–	2	–
Electrical Laboratory.........	140	–	6	–	6
Electron Tubes and High Frequency Circuits..........	308	1	–	1	–
Heat.......................	310	1	–	1	–
Mineralogy..................	260	1	–	1	–
Optics.....................	312	1	3	1	3
Organic Chemistry...........	110a	1	–	1	–
Physical Metallurgy..........	244	–	–	2	–
Theory of Potential and Electrical Measurements......	307	1	–	1	–
Option 5h, Applied Hydromechanics					
Aircraft....................	341	1	–	1	–
Alternating Current..........	139	1	–	1	–
Electrical Laboratory.........	140	–	3	–	3
Engineering Drawing.........	177	–	3	–	3
Heat.......................	310	1	–	1	–
Hydrodynamics..............	313	1	–	1	–
Optics.....................	312	–	–	1	3
Physical Metallurgy..........	244	–	–	2	–
Theory of Structures.........	7	1	–	1	–
Thermodynamics.............	225	2	–	2	3
Option 5e, Elasticity of Materials and Structures					
Alternating Current..........	139	1	–	1	–
Electrical Laboratory.........	140	–	3	–	3
Engineering Drawing.........	177	–	6	–	9
Optics.....................	312	1	3	1	3
Physical Metallurgy..........	244	–	–	2	–
Stress Graphics..............	10	1	–	1	–
Theory of Structures.........	7	1	–	1	–
Option 5i, Illumination and Acoustics					
Alternating Current..........	139	1	–	2	–
Electrical Laboratory.........	140	–	6	–	6
Thermionic Tubes............	150	1	–	1	3

THIRD YEAR SUBJECTS, DEPT. 5—*Continued*

Heat	310	1	–	1	–
Optics	312	1	3	1	3
Theory of Potential and Electrical Measurements	307	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5c, Electricity and Communications					
Advanced Mathematical Operations used in Physics	314	1	–	1	–
Acoustics	149	1	–	–	–
Advanced Acoustics	316	1	–	–	–
Applied Electricity	145a, 145b	3	–	3	–
Conduction through Gases, Radioactivity, and Atomic Structure	315	1	–	1	–
Differential Equations of Mathematical Physics	332	2	–	2	–
Electrical Laboratory	146	–	6	–	6
Electromagnetic Theory	153	2	–	2	–
Engineering Economics	125	–	–	1	–
Operational Calculus	152	2	–	2	–
Physical Laboratory	317	–	3	–	3
Radiotelegraphy	147. 148	2	6	2	6
Thesis	285	–	–	–	–
Option 5s, X-Rays and Spectroscopy					
Acoustics	149	1	–	–	–
Advanced Acoustics	316	1	–	–	–
Advanced Mathematical Operations Used in Physics	314	1	–	1	–
Advanced Optics	318	1	–	1	–
Conduction through Gases, Radioactivity, and Atomic Structure	315	1	–	1	–
Differential Equations of Mathematical Physics	332	2	–	2	–
Electromagnetic Theory	153	2	–	2	–
Elementary Quantum Theory	320	–	–	1	–
Engineering Economics	125	–	–	1	–
Operational Calculus	152	2	–	2	–

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5s, X-Rays and Spectroscopy (continued)					
Physical Laboratory	317	–	9	–	9
Radiotelegraphy	147, 148	2	6	2	6
Series Spectra	319	–	–	1	–
Thesis	285	–	–	–	–
X-Rays and Crystal Structure	321	1	–	1	–
Option 5g, Geophysics					
Differential Equations of Mathematical Physics	332	2	–	2	–
Dynamic and Structural Geology	198	1	–	–	–
Economic Geology	202, 203a	1	3	3	3
Electromagnetic Theory	153	2	–	2	–
Elementary Geology	195	–	–	2	–
Geophysics	322	2	9	2	9
Location of Mineral Deposits	203b	–	–	2	–
Mining Geology	200	–	–	2	–
Petrography	262, 263	1	2	1	2
Precambrian Geology	199	2	–	–	–
Wave Motion in Elastic Media	323	1	–	1	–
Option 5h, Applied Hydromechanics					
Advanced Mathematical Operations Used in Physics	314	1	–	1	–
Aerodynamics	342	2	–	2	–
Aircraft Engines	343	1	–	1	–
Airplane Design and Stress Analysis	344	2	9	2	9
Differential Equations of Mathematical Physics	332	2	–	2	–
Dynamic Meteorology	326	1	–	1	–
Hydrodynamic Laboratory	345	–	6	–	6
Theoretical Hydrodynamics	334	2	–	2	–
Thesis	285	–	4	–	4

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5e, Elasticity of Materials and Structures					
Advanced Mathematical Operations Used in Physics.....	314	1	–	1	–
Advanced Structural Analysis .	12a	2	6	2	6
Applied Elasticity............	10b	–	–	1	–
Differential Equations of Mathematical Physics....	332	2	–	2	–
Engineering Mechanics Laboratory....................	13a	–	6	–	6
Operational Calculus.........	152	2	–	2	–
Theory of Elasticity..........	333	1	–	1	–
Theory of Structures	12	2	–	2	–
Thesis......................	285	–	–	–	–
Wave Motion in Elastic Media.	323	1	–	1	–
and *one* of the following:					
(*a*) Vibration of Structures	23, 23a	1	3	1	3
(*b*) Vibration of Machines	23, 23a	1	3	1	3
Option 5i, Illumination and Acoustics					
Advanced Acoustics..........	316	1	–	–	–
Advanced Mathematical Operations Used in Physics......	314	1	–	1	–
Applications of Thermionic Tubes..................	151	1	3	1	3
Architectural Acoustics.......	191a	2	6	2	6
Differential Equations of Mathematical Physics....	332	2	–	2	–
Operational Calculus.........	152	2	–	2	–
Photometry and Illumination Design	192b	2	6	2	6
Physical Laboratory..........	325	–	3	–	3
Physics of Light Production...	324	1	–	1	–

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(DEPT. 6)

The course is designed to give the student a thorough training in the underlying principles and laboratory methods of inorganic, organic, physical and analytical chemistry, in the applications of these to industrial chemistry and chemical engineering, and a general knowledge of the elements of thermodynamics, hydraulics, machine design, structural design, electricity, and metallurgy. A preliminary training of this nature with subsequent practical experience will enable him to undertake the design and construction and also the operation and management of the plant required in such branches of chemical industry as are concerned with the production of chemical and pharmaceutical products, petroleum and its products, rubber goods, leather and glue, soap, meat products, foodstuffs, vegetable and animal oils, sugar, pulp and paper, vegetable and animal fibres, artificial silk, coal tar and wood distillates, paints and varnishes, explosives, dyes, portland cement, metals and their alloys, electrochemical products, fermentation products, fertilizers, etc.

For those who by temperament and ability are attracted to chemical research there exist excellent opportunities in government, industrial, and medical research laboratories. Properly qualified students wishing to pursue experimental investigation as a life-work whether in industrial chemistry or in purely scientific chemistry may proceed in this department to the degrees M.A.Sc. and Ph.D., the laboratory research work of the Fourth Year serving as a connecting link between the undergraduate and graduate courses.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 105.

FIRST YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Biological Laboratory........	80	–	–	–	3
Business....................	121	–	–	1	–
Chemical Laboratory........	86	–	13	–	12
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Drawing........	168	–	2	–	3
General Chemistry..........	85	2	–	1	–
German....................	265	2	–	2	–
Mineralogy Laboratory......	256	–	2	–	1
Optics....................	185b	1	3	1	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus...................	237	2	–	2	–
Applied Physics Laboratory ..	186	–	–	–	1
Chemical Laboratory........	92, 97	–	10	–	8
Economics and Finance......	123	1	–	1	–
Electricity..................	136, 137	2	3	2	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Drawing........	172	–	7	–	3
German....................	265	1	–	1	–
Hydrostatics................	212	–	–	1	–
Industrial Chemistry.........	94	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Industrial Chemistry.........	94a	–	–	–	5
Inorganic Chemistry.........	87a	1	–	–	–
Inorganic Chemistry.........	87b	–	–	1	–
Mechanics of Materials......	4	2	–	2	–
Metallurgy.................	241	–	–	1	–
Organic Chemistry..........	96	2	–	2	–
Physical Chemistry..........	98	2	–	2	–
Physical Training...........	280	–	2	–	2

THIRD YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry........	88	1	–	1	–
Assaying Laboratory.........	49	–	3	–	–
Chemical Laboratory...	100, 104a, 106	–	13	–	13
Chemical Plant.............	104	1	–	1	–
Electrical Laboratory........	144b	–	–	–	3
Electricity..................	143	1	–	1	–
Electrochemistry............	107, 108	2	3	–	–
Engineering Chemistry.......	102	1	–	1	–
Engineering Drawing........	177	–	3	–	3
German....................	265	1	–	1	–
Hydraulics.................	205, 206	2	–	2	1½
Industrial Chemistry.........	103	1	–	1	–
Metallurgy.................	243	1	–	1	–
Organic Chemistry..........	105	2	–	2	–
Physical Metallurgy.........	244	–	–	2	–
Theory of Structures.........	7	1	–	1	–
Thermodynamics............	217, 224	2	–	2	1½

FOURTH YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	111	–	17	–	–
German, *or*.................	265	1	–	1	–
Spanish................	266	1	–	1	–
Industrial Management......	130	1	–	1	–
Inorganic Chemistry.........	109	2	–	2	–
Machine Design.............	234	1	–	1	3
Organic Chemistry..........	110	1	–	1	–
Thesis....................	285	–	–	–	–
and *one* of					
1. Electrochemistry.........	114, 115	2	*	2	*
2. Industrial Chemistry	112, 113	1	*	1	*
3. Metallurgy and	247	1	*	1	*
Ore Dressing and	62, 63, 64	2	–	2	6
Physical Metallurgy.	250	1	*	1	*
4. Sanitary and Forensic Chem. and Bacteriology..	116	1	*	1	*
5. Zymology..............	283	*	*	*	*

*All time not otherwise allotted must be spent in the various laboratories in the proportions assigned by the Department.

For information regarding the courses of study leading to the degrees, Master of Applied Science and Doctor of Philosophy, see pp. 163 and 165 of this calendar, also the calendar of the School of Graduate Studies, which gives full particulars.

DEPARTMENT OF ELECTRICAL ENGINEERING
(DEPT. 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields beside that of his specialty, electrical technique. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but also thermodynamics, hydraulics, theory of mechanisms, machine design, business, economics and finance, commercial law, and other non-electrical subjects.

In the electrical field much time is given to calculation of circuits of electric, magnetic and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years. Certain options in this Year are available in combination with general electrical engineering; viz., hydraulics, thermodynamics, radiotelegraphy, electrochemistry and illumination.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial or administrative responsibilities.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 105.

FIRST YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Applied Physics.............	185a	1	3	1	3
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics.................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Engineering Drawing........	166	–	12	–	17
General Chemistry..........	84	2	–	1	–
Physical Training...........	280	–	2	–	2
Practical Experience.........	276	–	–	–	–
Statics....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus....................	237	2	–	2	–
Chemical Laboratory........	89	–	6	–	–
Descriptive Geometry........	162	1	–	1	–
Dynamics..................	335	2	–	2	–
Economics and Finance......	123	1	–	1	–
Electricity..................	136, 137	2	3	2	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Drawing........	170	–	9½	–	14½
Hydrostatics................	212	–	–	1	–
Inorganic Chemistry.........	87a	1	–	–	–
Mechanics of Materials.......	4	2	–	2	–
Organic Chemistry..........	95	–	–	1	–
Physical Training...........	280	–	2	–	2
Practical Experience.........	276	–	–	–	–
Steam Engines..............	216	1	–	1	–
Theory of Mechanism.......	230	2	1½	2	1½

THIRD YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	2	–
Commercial Law	124	1	–	1	–
Electrical Design	141, 142	1	3	1	3
Electrical Laboratory	140	–	6	–	6
Electrochemistry	107, 108	2	3	–	–
Engineering Chemistry	102	1	–	1	–
Heat Engines	218	1	–	1	–
Hydraulics	205, 206	2	–	2	3
Machine Design	233	2	3	2	6
Magnetism and Electricity	138	2	–	1	–
Mechanics of Machinery	231	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Practical Experience	276	–	–	–	–
Thermodynamics	217, 219	2	3	2	–

FOURTH YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Electricity	145, 146	5	20	5	19
Engineering Economics	125	–	–	1	–
Industrial Management	130	1	–	1	–
Practical Experience	276	–	–	–	–
Thesis	285	–	–	–	–
and *one* of					
1. Radiotelegraphy	147. 148, 149	3	9	2	9
2. Electrochemistry	114, 115	2	9	2	9
3. Hydraulics	207, 208, 209	3	9	3	6
4. Illumination	192, 192a	2	9	2	9
5. Thermodynamics	220, 221, 222	3	9	3	6

DEPARTMENT OF METALLURGICAL ENGINEERING
(Dept. 8)

This course is designed for those who intend to take up work in the production, treatment and working of metals for the purposes of industry; or the design, construction, or operation of metallurgical plants including smelters, furnaces, foundries, refineries, and lixiviation works; and administrative work in both engineering and industrial undertakings.

An optional course in this Department is provided in the Third and Fourth Years for those students who wish to become Ceramic Engineers. Ceramic plant experience, approved by the Department, will be necessary before the student will be given his degree. The Ceramic field includes the non-metallic mineral industry and the course given embraces the fundamentals of the manufacture of heavy clay products, porcelain, whiteware, earthenware, refractories, terra cotta, glass, enamelled iron, abrasives, gypsum products, cements, etc., as well as the raw materials used in these industries.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, Analytical Geometry, 238, page 105.

First Year Subjects Dept. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus................	236	2	–	2	–
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Drawing........	166	–	11	–	18
General Chemistry..........	85	2	–	1	–
Mineralogy.................	255, 258a	2	1	–	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	87a, 87b, 91	1	14	1	13
Economics and Finance	123	1	–	1	–
Electricity	136, 137	2	3	2	3
Engineering Drawing	172	–	3	–	6
Geology and Ore Deposits	196	1	1	1	1
Mechanics of Materials	4	2	–	2	–
Metallurgy	241, 242	1	–	2	–
Mining	51, 52	1	–	1	–
Physical Training	280	–	2	–	2
Steam Engines	216	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88	1	–	1	–
Assaying	45, 46	1	3	–	3
Cements and Concrete	11	1	–	–	–
Chemical Laboratory	101	–	–	–	6
Electricity	143,144c	1	3	1	3
Electrochemistry	107, 108	2	3	–	–
Engineering Drawing	182	–	3	–	–
Engineering Chemistry	102	1	–	1	–
Heat Engines	218	1	–	1	–
Metallurgy	245	2	3	1	6
Ore Dressing	58, 59	1	3	1	3
Physical Metallurgy	246	1	3	1	–
Physics of Ore Dressing	64	1	–	1	–
Thermodynamics	223, 224	1	–	1	3

THIRD YEAR SUBJECTS DEPT. 8 (a) CERAMIC OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Cements and Concrete	11	1	–	–	–
Ceramic Calculations	254c	–	–	1	–
Ceramic Laboratory	254e	–	6	–	6
Ceramics, General and Mfg.	254a	4	–	2	–
Clay Testing	254d	–	9	–	3
Electricity	143, 144b	1	–	1	3
Elementary Petrography	260	1	–	1	–
Engineering Chemistry	102	1	–	1	–
Engineering Drawing	177	–	6	–	5
Engineering Geology	197	1	–	1	–
Glazes	254b	–	–	2	–
Heat Engines	218	1	–	1	–
Physical Chemistry	98	2	–	2	–
Theory of Structures	7	1	–	1	–
Thermodynamics	223, 224	1	–	1	3

FOURTH YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	47, 48	–	–	1	3
Contracts and Specifications	127	–	–	1	–
Electrochemistry	114, 115	2	–	2	6
Engineering Economics	125	–	–	1	–
Hydraulic Laboratory	210	–	–	–	3
Machine Design	234	1	–	1	3
Metallurgy	249	1	–	1	–
Metallurgy Problems	248	2	4	2	4
Ore Dressing	60, 61	1	6	1	–
Physical Metallurgy	250	1	3	1	3
Plant Management	129	–	–	1	–
Thesis	285	–	6	–	6

FOURTH YEAR SUBJECTS DEPT. 8 (a) CERAMIC OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Ceramic Laboratory	254i	–	7	–	9
Ceramic Products and Spec'ns	254h	–	–	1	–
Commercial Law	124	1	–	1	–
Contracts and Specifications	127	–	–	1	–
Glass and Enameled Iron	254g	–	–	2	–
Machine Design	234	1	–	1	3
Petrography	262, 263	1	2	1	2
Plant Management	129	–	–	1	–
Pleistocene Geology	194, 201	1	3	1	–
Refractories and Ceramic Bodies	254f	2	–	–	–
Silicate Chemistry	116a	2	–	–	–
Structural Design	18	1	–	–	–
Structural Design Drawing	183	–	6	–	6
Thesis	285	–	9	–	8

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 1. Applied Mechanics—Statics, means the course of lectures indicated by this number in the table of curriculum for the First Year on page 25.

APPLIED MECHANICS AND DESIGN OF STRUCTURES

1. Applied Mechanics—Statics. T. R. Loudon.

All departments I Year; 2 hrs. per week, both terms.

This course of lectures deals with the fundamental principles of the laws of equilibrium of forces. These principles are applied to the determination of stresses in simple structures. Toward the end of the course an introduction to Mechanics of Materials is given.

Text: Analytical Mechanics for Engineers—Seely and Ensign.

2. Applied Mechanics—Dynamics. M. J. C. Lazier.

Departments 1, 2, 3, 6, 7, 8, I Year; 2 hrs. per week, both terms.

This course of lectures is designed to extend the elementary principles of preparatory school mechanics to a more general viewpoint. Under the heading of Kinematics, the general equations of motion, both linear and angular, are developed.

Centres of mass and moments of inertia are calculated.

The principles of linear and angular momentum are dealt with and a fairly comprehensive course on effective and inertia forces as applied to engineering problems is given. The discussion of energy, work and power is extended as far as possible to practical problems.

Simple Harmonic Motion is also discussed.

Text: Tutorial Dynamics—Briggs and Bryan. Analytical Mechanics for Engineers—Seely and Ensign. Introduction to Mechanics—J. W. Campbell.

3. Applied Mechanics—Dynamics. T. R. I oudon, M. J. C. Lazier.

Department 3, II Year; 1 hr. per week, both terms.

This course of lectures extends the work of the First Year to more general applications, such as: bodies moving with general plane motion, compound pendulum, gyroscopic action. A short discussion of the fundamental theory of hydrodynamics with particular reference to determining stream line flow is included in these lectures.

Texts: Analytical Mechanics for Engineers—Seely and Ensign. Hydromechanics, Part II—Ramsey.

4. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Departments 1, 2, 3, 5, 6, 7, 8, II Year; 2 hrs. per week, both terms.

In this course, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Reference book: Strength of Materials—Case.

5. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Department 4, II Year; 2 hrs. per week, both terms.

This course deals with the mathemactical consideration of stress and elasticity. Among the problems taken up are the consideration of riveted joints, theory of simple and continuous beams, the theory of columns and simple column footings.

Text: Strength of Materials—Boyd.

5*a*. Applied Mechanics—Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Depatrment 5, I Year; 2 hrs. per week, both terms.

This course of lectures deals with the determination of stresses in simple framed structures and beams. The course also includes an elaboration of the kinematics and kinetics of masses having particular reference to simple mechanical parts.

Text books: Analytical Mechanics for Engineers—Seely and Ensign.

5*b*. Applied Mechanics—Advanced Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Department 5, III Year; 1 hr. per week, both terms.

This course of lectures deals with advanced theory of harmonic motions as applied to stress analysis in engineering problems. The theories of elasticity are also elaborated in this course and applied to various types of structural examples.

6. Theory of Structures. C. R. Young, C. F. Morrison.

Department 1, III Year; 2 hrs. per week, both terms.

The work of the first term comprises a discussion of timber beams, and details, combined stresses, columns, trussed beams, box girders, and plate girders. A number of designs of structures and structural details are worked out in the class and drafting rooms.

The second term is given chiefly to moving loads, the design of a riveted truss highway span and the theory of railway truss spans. Problems relating to the design of typical structures of these types are worked out in the lecture and drafting rooms.

Texts: Modern Framed Structures, Part III—Johnson, Bryan and Turneaure. Structural Members and Connections—Hool and Kinne. Elementary Structural Problems—Young. A.I.S.C. Handbook, Steel Construction. Structural Design in Steel—Shedd.

7. Theory of Structures. C. F. Morrison.

Departments 2, 3, 5e, 6 and 8a, III Year; 1 hr. per week, both terms.

The work is practically the same as that for course 6 in the first term.

8. Structural Design. C. F. Morrison.

Department 4, III Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

The stress analysis of simple structures is discussed in this course. Practical problems on the design of beams, columns, piers, footings, and roof trusses are worked out in the drafting room. An introduction to reinforced concrete is also given.

Reference Book: Architectural Construction—Gay and Parker.

9. Mechanics of Materials. C. R. Young, W. L. Sagar.

Departments 3 and 5, II Year, Department 2, IV Year, 3 hrs. per week, one term; Department 1, III Year, 5 hrs. per week, one term.

This laboratory course is intended to give the student an introduction to the experimental study of the strength and elasticity of materials. It is intended that he shall acquire some familiarity with the construction and operation of testing machines and with the properties of ordinary materials of construction.

Reference: Junior Laboratory Course in Mechanics of Materials, Department of Civil Engineering; Municipal and Structural.

10. Stress Graphics. C. F. Morrison.

Departments 1 and 5e, III Year; 1 hr. per week, both terms.

This course of lectures deals with graphic methods of determining stresses in framed structures, the construction of shearing force diagrams, bending moment diagrams and influence lines. Some attention is also given to the principles of formula charting.

Text book: Graphic Analysis—Wolfe.

10*a*. Applied Elasticity. T. R. Loudon.

Department 1, III Year; 1 hr. per week, both terms.

In this course of lectures, the fundamental principles of elasticity are extended to apply to the determination of deformations and stresses in several of the well known types of structures and structural members where ordinary statical methods fail to give a solution of the problem.

Texts: Applied Elasticity—Timoshenko and Lessels. A Treatise on the Mathematical Theory of Elasticity—Love.

10*b*. Applied Elasticity. T. R. Loudon.

Department 5e, IV Year; 1 hr. per week, second term.

Deformations and stresses in plates and slabs variously supported and variously loaded, in railway rails and ties, in footings, in the heads of pressure vessels, and in structures composed of dissimilar materials subjected to temperature changes, shrinkage and flow.

11. Cements and Concrete. C. F. Morrison, W. L. Sagar.

Department 1, III Year; 1 hr. per week, both terms.

Departments 8 and 8a, III Year; 1 hr. per week, first term.

The manufacture, testing and use of Portland cement and the fundamentals of the theory of reinforced concrete are discussed in this course of lectures.

Reference books: Reinforced Concrete Design—Sutherland and Cliffoed. Reinforced Concrete Construction, Vol. I—Hool. Design of Concrete Structures—Urquhart and O'Rourke.

12. Theory of Structures. C. R. Young.

Departments 1a and 5e, IV Year; 2 hrs. per week, both terms.

The work comprised in this course of lectures concerns arches, suspension bridges, cantilever bridges, movable bridges, deflections, statically indeterminate systems, and secondary stresses. Problems based on the lectures are worked out in the drafting rooms.

Reference books: Modern Framed Structures, Part II—Johnson Bryan and Turneaure.

12*a*. Advanced Structural Analysis. C. R. Young, C. F. Morrison.

Department 5e, IV Year; 2 hrs., lecture, and 6 hrs. laboratory per week, both terms.

Flexural deformations are thoroughly investigated by the methods of single and double integration, by moment areas, shear areas, elastic weights, dummy loads, and Castigliano's first theorem. This is followed by a consideration of shear deformations, applications of the slope-deflection method and modifications of it, applications of the method of moment distribution, with modifications, stress determination by the method of least work, by Castigliano's second theorem, by the ellipse of electricity method, the column analogy method and the fixed-point method.

13. Mechanics of Materials. C. R. Young, W. L. Sagar.

Department 1a, IV Year; a laboratory course of 3 hrs. per week, both terms.

This course of experiments is intended to give the student practice in investigating the elastic and physical properties of iron, steel, concrete, timber, etc., and in the use of instruments of precision designed for that purpose.

Reference book: Materials of Construction—Johnson.

13*a*. Engineering Mechanics. The staff in Civil Engineering.

Department 5e, IV Year; 6 hrs. per week laboratory, both terms.

Elastic properties of the materials of construction. Experimental determination of the elastic behaviour of, and stresses in, members and structures by means of mechanical and optical models.

14. Foundations, Retaining Walls and Dams. T. R. Loudon, W. J. Smither.

Department 1a, IV Year; 1 hr. per week, both terms.

This course of lectures is devoted to the design of the structures mentioned. The most approved forms of construction of retaining walls, footings, abutments, piers and dams are described, and typical designs are worked out in the class and drafting rooms.

Text books and books of reference: Retaining Walls for Earth—M. A. Howe. Walls, Bins and Grain Elevators—M. S. Ketchum. Design and Construction of Dams—E. Wegmann.

14*a*. Soil Mechanics. C. R. Young.

Department $1a_1$ and $1a_2$, IV Year; 1 hr. lecture per week, first term.

A course of lectures devoted to those physical and mechanical properties of soils of importance to the engineer, such as compressive and cohesive strengths, internal friction, stability in slopes, compressibility and other deformational characteristics, permeability and moisture retention. The bearing of these properties on the design and construction of engineering works is considered in detail.

15. Reinforced Concrete. C. R. Young.

Department 1a, IV Year; 1 hr. per week, both terms.

The theory of the strength of reinforced concrete elements including the beam, the slab, the T-beam, the column and the girderless floor, is continued in this course.

The analysis of the monolithic arch by the elastic theory is discussed, and the student is required in the drafting room to apply his knowledge to the design of simple structures.

Reference books: Principles of Reinforced Concrete Construction—Turneaure and Maurer. Reinforced Concrete Design—Sutherland and Clifford.

16. Structural Design. C. F. Morrison.

Department 4, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

In this course the properties of the materials used and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of columns, beams, and slabs are made. The lectures are supplemented by the working of problems in the drafting room.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Architectural Construction—Gay and Parker.

17. Structural Design. C. R. Young, W. J. Smither.

Department 1a, IV Year; 1 hr. per week, both terms.

Department 3, IV Year; 1 hr. per week, first term.

In this course of lectures consideration is given to such matters as mill construction buildings, economic arrangement of building frames, probable loadings for girders and columns, column eccentricities, crane runways, cable ways, wind bracing, and rigid frames.

Text books: Handbook of Building Construction—Hool and Johnson. Architects' and Builders' Handbook—Kidder-Parker.

18. Structural Design. C. R. Young, W. J. Smither.

Departments 1a, 3 and 8a, IV Year; 1 hr. per week, first term.

Consideration is given in this course to the various types of mill buildings, to the conditions governing their choice and to the design and details of construction in different materials. Designs of portions of mill buildings are worked out in the class and drafting rooms.

Text books: Steel Mill Buildings—Ketchum. Mill Buildings—Tyrrell.

19. Miscellaneous Structures. W. J. Smither.

Department 1a, IV Year; 1 hr. per week, second term.

In this course of lectures the application of theoretical principles to the design of a variety of structures is made. Among those structures discussed are transmission line towers, elevated tanks and their supporting towers, standpipes, large pressure pipes, sewers, culverts, small highway bridges, sub-surface tanks and tall chimneys. Whenever possible the lecture work is followed up by designs in the drafting room.

20. Reinforced Concrete. C. F. Morrison.

Department 3, IV Year; 1 hr. per week, first term.

In this course the properties of the materials involved and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of columns, beams, floors and footings are made.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete Construction, Vol. I—Hool. Design of Concrete Structures—Urquhart and O'Rourke.

21. Structural Design. T. R. Loudon.

Department 4, V Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

In this course the students apply the principles of structural design to problems in which actual buildings are designed and detailed.

23. Vibration Engineering. M. J. C. Lazier.

Department 5e, IV Year; 1 hr. per week, both terms.

Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

23*a*. Vibration Laboratory. M. J. C. Lazier.

Department 5e, IV Year; 3 hrs. per week, both terms.

A series of experiments designed to give familiarity with the nature of vibrating systems and the causes, measurement and control of vibration in engineering problems. The assignment of experiments will depend on whether the student has elected for special study (*a*) Vibration of Structures, or (*b*) Vibration of Machines.

ARCHITECTURE, DRAWING AND PAINTING

25. History of Architecture. H. J. Burden.

Department 4, I Year; 1 hr. per week; both terms.

In this course the development of architecture and ornament is traced from pre-historic times to the close of the Byzantine Period.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. The Architecture of Ancient Greece—Anderson, Spiers, and Dinsmoor. The Architecture of Ancient Rome—Anderson, Spiers, and Ashby. The Grammar of Ornament—Owen Jones.

25*a*. History of Architecture. H. J. Burden.

Department 4, II Year; 1 hr. per week; both terms.

In this course the development of architecture and ornament is traced from the Romanesque Period to the end of the Gothic Period.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. Medieval Architecture—Arthur Kingsley Porter. Gothic Architecture in England — Francis Bond. The Grammar of Ornament—Owen Jones.

25*b*. History of Architecture. H. H. Madill.

Department 4, III Year; 1 hr. per week, first term.

In this course the architecture of the Renaissance in Italy and France is taken in detail.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. Architecture of the Renaissance in Italy—Anderson and Stratton. The Architecture of the Renaissance in France, Vol. 1 and 2—W. H. Ward. The Renaissance of Roman Architecture—T. G. Jackson.

25*c*. History of Architecture. E. R. Arthur.

Department 4, III Year; 1 hr. per week, second term.

This course of lectures covers the period 1500-1900 in England. Lectures on furniture are given in this course with special reference to the development of furniture in England from Mediaeval times.

Reference books: Growth of the English House—J. Alfred Gotch. A History of Renaissance Architecture in England, Vol. 1 and 2—R. Blomfield. History of Domestic Architecture in Britain during the Tudor Period—Thomas Garner and Arthur Stratton. Houses of the Wren and Early Georgian Period—Turnstall Small and Christopher Woodbridge. Mouldings of Wren and Georgian Periods—T. Small and C. Woodbridge. Robert Adam and his Brothers—John Swarbrick.

26. Functional Requirements of Buildings. A. S. Mathers.

Department 4, III and IV Years; 1 hr. per week, both terms.

In this course of lectures the principles underlying the planning of such large buildings as churches, departmental stores, theatres, schools, railway stations, etc., are discussed in detail.

27. Garden Design. H. B. Dunington Grubb.

Department 4, III Year. Special lectures, first term.

In this course the historical development of Garden Design is traced from earliest times; the study of sites; the influence of topography, orientation, access, etc., on the problems of design; site planning; the location of buildings; the solution of an actual problem on a typical site.

27*a*. Garden Design. H. B. Dunington Grubb.

Department 4, IV Year. Special lectures, first term.

The work of the previous year is continued and a problem is set in the studio involving principles of both architectural and garden design.

28. Elements of Architectural Form. E. R. Arthur.

Department 4, I Year; 1 hr. per week, both terms.

The elements of architectural form consist of the study of doors, windows, columns, wall treatment, roofs, mantels, chimney stacks, etc. These are examined without regard to particular style and from the standpoint of design rather than construction.

Reference books: Theory and Elements of Architecture, Vol. 1, Part 1—Robert Atkinson and Hope Bagenal. Fragments Antique, Vol. I and II—D'Espouy. The English Fireplace—L. A. Shuffrey. The Design of Lettering—Egon Weiss.

30. History of Fine Art. C. W. Jefferys.

Department 4, IV Year; 1 hr. per week, both terms.

The course consists of an outline of the history and development of painting and of the minor pictorial arts from the earliest time until the present day, followed by an outline of the history and development of the different eras of sculpture ranging from the primitive to the present day.

31. Architectural Design. H. H. Madill, E. R. Arthur, W. E. Carswell.

Department 4, I Year. 12 hrs. per week, both terms.

This comprises work done in the studio, including lettering, drawing, and rendering such elementary studies as a door, a window, etc., and exercises in simple composition.

An elementary design is carried to the stage of working drawings. Furniture, mantels, etc., in the Royal Ontario Museum are drawn to scale.

31*a*. Architectural Design. E. R. Arthur, Mackenzie Waters.

Department 4, II Year. 15 hrs. per week, both terms.

This course is given by means of individual instruction in the studio, and by criticisms of the solutions of different problems set during the year. It is in this course that the student begins the serious study of design; continued practice in architectural drawing and rendering affords the training necessary to make of the student a proficient draughtsman.

31*b*. Architectural Design. E. R. Arthur, Mackenzie Waters.

Department 4, III Year. 20 hrs. per week, both terms.

This course is given by individual instruction in the studio and by criticisms of solutions of problems set during the year. The greater part of the course is devoted to problems in design and forms a continuation of the course given in the preceding year.

One of the students' designs of a building is carried through to the stage of working drawings.

31*c*. Architectural Design. E. R. Arthur, Mackenzie Waters.

Department 4, IV Year. 20 hrs. per week, both terms.

This course is a continuation of the work of the preceding years, being given by individual instruction in the studio and criticisms of the solution of problems set during the year.

31*d*. Architectural Design. E. R. Arthur, Mackenzie Waters.

Department 4, V Year. 26 hrs. per week, both terms.

The course of the preceding year is continued in more advanced problems.

One of the students' designs of a building is carried through to the stage of working drawings.

31*e*. Architectural Engineering. H. H. Madill, T. R. Loudon.

Department 4, IV Year; Architectural Engineering Option.

In this course lectures on structural design and layout are given and problems are worked out in the studio. The work is coordinated with problems set in architectural design.

31*f*. Architectural Engineering. H. H. Madill, T. R. Loudon.

Department 4, V Year; Architectural Engineering Option.

In this course the design and preparation of working drawings and structural details of work of a monumental character are carried on in the studio. The student is also required to take such lectures as are prescribed from time to time. The work is coordinated with problems set in architectural design.

32. Theory of Architectural Planning. E. R. Arthur.

Department 4, II Year.

In this course the general principle of planning (symmetrical and asymmetrical) of buildings from the small to complex problems are demonstrated. In the Second Term actual plans of libraries, banks, houses, etc., are studied as an aid to problems in design and a preliminary to work in the following year.

Reference books: Elements of Form and Design in Classic Architecture—Arthur Stratton. The Modern House—F. R. S. Yorke. The Smaller English House of the Later Renaissance, 1660-1830—A. E. Richardson and H. D. Eberlein. The Plan Requirements of Modern Buildings—V. O. Rees.

33. Architectural Composition. E. R. Arthur.

Department 4, III Year.

This course consists of a series of lectures on the theory of architectural design, the analysis of composition, proportion, scale, etc.

Illustrated lectures are given on Modern Architecture.

Reference books: Principles of Architectural Composition—Howard Robertson. Modern Architectural Design—Howard Robertson. The Architecture of Humanism—Geoffrey Scott. The Gothic Revival—Kenneth Clark. Towards a new Architecture—Le Corbusier. The Study of Architectural Design—J. F. Harbeson.

34. Architectural Aspects of Town Planning. E. R. Arthur.

Department 4, V Year; 1 hr. per week, second term.

In this course of lectures the historical development of town planning is traced with particular reference to the Axial Planning of the Renaissance, public squares, the grouping of buildings and the placing of monuments.

35. Freehand Drawing and Water Colour Painting. H. J. Burden, W. E. Carswell.

Department 4, I Year; 2 hrs. per week, both terms.

Drawing from still life, primary free hand perspective, primary pencil, charcoal, and pen and ink rendering.

35*a*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Department 4, II Year; 2 hrs. per week, both terms.

Drawing and monochrome painting from still life, drawing from the cast, pencil, pen and ink, and monochrome rendering, primary water colour, drawing from landscape and natural objects.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*b*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Department 4, III Year; 2 hrs. per week, both terms.

Drawing from the cast, water colour from still life, water colour rendering, drawing from landscape and natural objects.

Students who are sufficiently advanced are admitted to the Fourth Year Life Drawing Class.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*c*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Departent 4, IV Year; 2 hrs. per week, both terms.

Water colour from still life and from landscape, drawing from life.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*d*. Water Colour and Life Drawing. C. W. Jefferys.

Department 4, V Year; 2 hrs. per week, both terms.

Advanced water colour drawings and murals; drawings from life.

36. Modelling. Frederick Coates.

Department 4, II Year; 2 hrs. per week, both terms.

Scale models of architectural forms.

36a. Modelling. Frederick Coates.

Department 4, III Year; 2 hrs. per week, both terms.

Scale models of simple buildings.

36*b*. Modelling. Frederick Coates.

Department 4, IV Year; 2 hrs. per week, both terms.

Scale models of buildings and settings.

37. Building Construction. H. H. Madill.

Department 4, I Year; 1 hr. per week, second term.

Instruction is given in elementary construction using common building materials. The detailing of doors, windows, roofs, etc.

Reference books: Architectural Building Construction, Vol. 1—Jaggard and Drury. Building Construction, Vol. 1—V. F. Mitchell. Architectural Graphic Standards—Ramsey and Sleeper.

38. Building Materials. H. H. Madill.

Department 4, IV Year; 2 hrs. per week, both terms.

Properties and the use of the various materials used in building are studied from the architectural rather than the structural viewpoint.

A small exhibition room has been set aside in which examples of the most modern materials and devices are displayed. This room is open to the student at all times.

Reference books: Architectural Construction, Vol. 1—Voss and Henry. Builders Materials—R. F. B. Grundy. Brickwork—W. R. Jaggard. Lumber and its uses—R. S. Kellog. Building Construction, Vol. 1 and 2—Jaggard and Drury. Rivingtons Notes on Building Construction, Part I and II—W. N. Twelvetrees.

39. Sanitary Science. H. H. Madill.

Department 4, IV Year; 1 hr. per week; both terms.

Modern plumbing, its design and installation, drainage, sewerage disposal and water supply.

Reference books: Mechanical and Electrical Equipment for Buildings—Gay and Fawcett.

39*a*. Professional Practice. H. H. Madill.

Department 4, V Year; 1 hr. per week, both terms.

This course of lectures is designed to give an understanding of the professional character of the practice of architecture. In it are discussed the ethical, business and legal relations of the architect to clients, contractors, craftsmen, engineers and the professional bodies. The methods of office practice are also discussed.

Reference books: Architectural Practice and Procedure—H. H. Turner. The Architects Law Manual—C. H. Blake. The Law of Architecture and Building—C. H. Blake. Handbook of Architectural Practice A.I.A. Contract Forms of R.A.I.C. Code of Architectural Competitions O.A.A. Standard Specifications A.I.A.

40. Heating and Air Conditioning. A. Wardell.

Department 4, V Year; 1 hr. per week, both terms.

In this course of lectures the different systems of heating, ventilating and air conditioning of buildings are discussed.

40*a*. Architectural Economics. W. S. Wilson.

Department 4, V Year; 1 hr. per week, both terms.

A course of instruction in the various methods of preparing estimates, together with practical work in taking off quantities.

41. Vacation Work. H. H. Madill.

Department 4, II Year.

Each student is required to submit a set of twenty pages of notes on building construction on or before the opening day of the session. These notes are to consist of freehand pencil drawings with figured dimensions. Instruction as to the nature of these notes will be given by Prof. Madill before the close of the previous session.

42. Vacation Work. E. R. Arthur.

Department 4, III Year.

Each student is required to submit on or before the opening day of the session a set of measured drawings of existing buildings, and details of buildings, the building first to be approved by Prof. Arthur, who will also decide the number and size of the drawings to be made. The record of measurements must be preserved in a notebook which will be submitted with the final drawings.

43. Vacation Work. H. J. Burden, W. E. Carswell.

Department 4, IV Year.

Each student is required to submit on or before the opening day of the session a set of at least seven outdoor sketches in water colour, pen and ink, or pencil. The minimum size for each sheet will be $9'' \times 12''$. Of these sketches at least four will be in pencil and at least three will be of an architectural character.

44. French. Miss J. C. Laing.

Department 4, I Year; 2 hrs. per week, both terms.

A. Reading of texts illustrative of French life; brief study of the geography of France; practice in conversation.

B. Outline of the history of Western Europe to 1500 A.D., with special reference to development of French and Italian civilization and culture.

Reference books: The Ordeal of Civilization—James Harvey Robinson. History of Medieval Europe—Thorndike. A History of France—William S. Davis. A short History of France, A Short History of Italy—Henry Dwight Sedgwick. Autobiography—B. Cellini. Leonardo da Vinci—Merejowski.

44*a*. French. Miss J. C. Laing.

Department 4, II Year; 2 hrs. per week, both terms.

A. Continuation of the work of the I Year.

Text: Michelet's Histoire de France—Buffum.

B. Outline of the history of Western Europe during the Renaissance period.

Reference books: The Renaissance and the Reformation—Lucas. A Political and Cultural History of Modern Europe, Vol. 1—Hayes. A Short History of France, A Short History of Italy—Sedgwick. National History of France, The Century of the Renaissance—Batiffol. The Seventeenth Century—Boulenger.

44*b*. French. Miss J. C. Laing.

Department 4, III Year; 1 hr. per week, both terms.

A. Continuation of the work of the II Year.

B. Brief outline of history of the French Revolution and modern France.

Reference books: A Short History of France—Sedgwick. National History of France, The Eighteenth Century—Stryienski. French Society in the Eighteenth Century—Ducros.

ASSAYING, MINING AND ORE DRESSING

The work in Mining is directed more to the development of the proper attitude of mind towards mining problems than to the teaching of actual mining methods.

The teaching of Assaying has a two-fold function. The first is to give the student a working knowledge of the practice of the art, so that he can earn money as an assayer on graduation and use this as a stepping-stone to other positions. The second is to use the assaying laboratories for the training of students in certain important phases of engineering methods. The size of the apparatus, the completeness of the processes in short intervals of time, the extreme accuracy of results when so desired, the relation of the extent of error to time and method, the similarity of the academic laboratory to the field laboratory—all these permit an unrivalled opportunity for driving home much broad engineering philosophy. The assaying processes and apparatus lend themselves peculiarly well to the development of a proper perspective in regard to errors and accuracy in measurements.

The study of Ore Dressing, when accompanied by laboratory work in a well-equipped ore dressing laboratory, is one of the most important of the Mining Engineering subjects. Not only is the mechanical treatment of ores a very important branch of Mining Engineering, but the mental processes involved in a study of the fundamental principles underlying the art, and the compromise necessary for field practice form one of the best fields for the development of engineering philosophy. From these points of view, the ore dressing laboratory is exceptionally well equipped.

45. Assaying. J. T. King.

Departments 2 and 8, III Year; 1 hr. per week, first term.

A first course of lectures on the theory of fire assaying. Emphasis is laid not only on the chemical and metallurgical principles involved, but upon the errors inherent in operators as well as in methods.

Text Book: Manual of Fire Assaying—Fulton and Sharwood.

46. Assaying. J. T. King.

Departments 2 and 8, III Year; 3 hrs. per week, both terms.

A laboratory course in the determination of the precious metals in ores, milling and metallurgical products. Scorification and crucible assays of ores and products, pure and impure, fluxes, slags and solutions. Buckboard practice, ores with metallics. Copper and lead by electrolysis. Students are expected to do their later assays with despatch and a reasonable degree of accuracy. Neatness of work is required.

47. Assaying. J. T. King.

Departments 2 and 8, IV Year; 1 hr. lecture per week, second term.

A continuation of course 45. Complex ores. Combination assays. The sampling and assay of bullion. The platinum group metals. Checks and corrections.

48. Assaying. J. T. King.

Departments 2 and 8, IV Year; 3 hrs. per week, second term.

An advanced laboratory course in which some of the methods of course 47 are used.

49. Assaying. J. T. King.

Department 6, III Year; 3 hrs. per week, first term.

An introductory laboratory course for chemical engineers. Some lecture instruction is given. An abbreviation of courses 45 and 46.

50. Mining. H. E. T. Haultain, F. C. Dyer.

Department 2, I Year; 3 hrs. per week, second term.

A laboratory course, including some lectures, being an introduction to certain mining and milling machinery and methods.

51. Mining. H. E. T. Haultain.

Departments 2 and 8, II Year; 1 hr. per week, first term.

An introductory course of lectures.

52. Mining. H. E. T. Haultain.

Department 8, II Year; 1 hr. per week, second term.

An extension of course 51.

53. Mining. F. C. Dyer.

Department 2, II Year; 3 hrs. per week, first term.

A continuation of course 50. Rock drills, sampling methods, use of explosives.

54. Mining. H. E. T. Haultain, F. C. Dyer.
Department 2, III Year; 1 hr. per week, both terms.
Principles of mining.

55. Mining. H. E. T. Haultain.
Department 2, IV Year; 1 hr. per week, both terms.
Special problems, estimates, reports.

56. Mine Cost Finding and Management. H. E. T. Haultain.
Department 2, IV Year; 1 hr. per week, both terms.
One of the fundamental features that must not be lost sight of by the mining engineer is, that his work is designed primarily for purposes of financial profit. This course of lectures deals with details from this point of view. The total cost of a ton of ore requiring as it does an understanding of the problems of amortization, is first dealt with in a broad way. Then are considered various problems of cost finding, leading on to problems of time and motion study which are essential to the development of the fine points of the art in any particular mining problem. The latter part of the course deals with problems of management, the relation of members of the staff to each other, and the relations of the staff to labour.

58. Ore Dressing. H. E. T. Haultain, F. C. Dyer.
Departments 2 and 8, III Year; 1 hr. per week, both terms.
The general principles of Ore Dressing.

59. Ore Dressing. F. C. Dyer,
Departments 2 and 8, III Year; 6 continuous hrs. per week, second term.
Work with crushing machinery, principles of crushing and grading, screen analyses, concentration with gravity separation apparatus, etc.

60. Ore Dressing. H. E. T. Haultain, F. C. Dyer.
Departments 2 and 8, IV Year; 1 hr. per week, both terms.
Course 58 continued, study of flow sheets and special problems.

61. Ore Dressing. F. C. Dyer.
Departments 2 and 8, IV Year; 6 continuous hrs. per week, first term.
Advanced work with ore dressing appliances, ore testing and check mill runs.

62. Ore Dressing. F. C. Dyer.
Department 6m, IV Year; 1 hr. per week, both terms.
General principles of Ore Dressing.

63. Ore Dressing. F. C. Dyer.
Department 6m, IV Year; 1 period of 6 hrs. per week, second term.
Principles of sampling, crushing and grading, screen analyses, concentration with gravity separation apparatus, flotation, ore testing, etc.

64. Physics of Ore Dressing. F. C. Dyer.

Department 2 and 8, III Year and Department 6m, IV Year; 1 hr. per week, both terms.

Ore dressing methods involve a study of the laws governing the phenomena of surface tension, capillarity and colloidal solutions, in addition to those of hydrostatics and certain phases of hydraulics. This is embodied in a special course of lectures in conjunction with laboratory work in the ore dressing laboratory.

65. Theory of Measurements. H. E. T. Haultain, F. C. Dyer.

Department 2, II Year; 1 hr. per week, first term.

This title is not an entirely suitable one for this course of lectures because it is generally applied to a study of the philosophy of extremely accurate measurements. The mining engineer has to continually make satisfactory use of measurements with a wide range of inaccuracy. This course of lectures deals with the philosophy underlying the causes of these errors and the practical application of such approximations. The opportunity is taken in these lectures to deal with the subject of illustrating measurements by graphs.

66. Introductory Research. H. E. T. Haultain, F. C. Dyer.

Department 2, III Year; 3 hrs. per week, first term.

This is a laboratory course including some lectures and is a preparation for the thesis of the Fourth Year.

67. Thesis.

Department 2, IV Year; 7 hrs. per week, first term; 10 hrs. per week, second term, in continuous periods.

Thesis in this department consists mainly in reports on original work done in the laboratories. In the Third Year the subject "Introductory Research" paves the way for the thesis. By October 15th the student decides on the subject of his thesis in consultation with his professors. After this is decided the student uses his own initiative in the development of his work.

The thesis is divided into three parts. The first part, which is handed in not later than October 15th, contains the title, a statement of what the title is meant to convey and an outline of the work that is proposed to be done. The second part is handed in during the first week of January and contains a report of progress to date and enables the professor in charge to keep in closer touch with the work. The third and final part is handed in a week before the examinations and is a report of progress to date with final conclusions. The three parts combined constitute the thesis.

69. Vacation Work. H. E. T. Haultain.

Department 2, III Year.

This is a series of letters written during the summer vacation, dealing with various aspects of a mining engineer's work. These

are intended to direct and help the student's powers of observation, analysis and criticism as well as being exercises in the art of lucid technical expression.

Special instructions will be issued in connection with these letters.

70. Vacation Work. H. E. T. Haultain.

Department 2, IV Year.

Special instructions will be given in connection with this work.

ASTRONOMY AND GEODESY

71. Astronomy, Elementary. P. M. Millman.

Department I, II Year; 1 hr. per week, both terms.

A course in descriptive Astronomy, explaining the ordinary astronomical terms, and describing the various celestial bodies and their motions. In the evenings opportunity will be given for identifying the stars and for observing with telescopes.

Text book: Elements of Astronomy—Fath.

72. Astronomy and Geodesy. S. R. Crerar.

Department 1, III Year; 2 hrs. per week, both terms.

The course of lectures deals with the determination of time, latitude, longitude and azimuth, by methods adapted to the use of the surveyor's transit and the sextant. It is designed to fulfil the requirements of the final examinations for Ontario and Dominion Land Surveyors.

In Geodesy an account is given of the principles and methods of a secondary triangulation survey, also of the principles involved in the North-west system of survey.

Text books: Practical Astronomy as applied to Geodesy and Navigation—Doolittle. Notes on Practical Astronomy and Geodesy. Nautical Almanac.

73. Field Work. S. R. Crerar.

Department 1, III Year; about 2 hrs. per week, first term.

The practical work in this subject comprises observations in the field with the transit and sextant for the determination of time, latitude and azimuth by the methods described in the lectures and the solution of related problems.

74. Astronomy (Advanced). J. W. Melson.

Department 1b, IV Year; 2 hrs. per week, both terms.

The lecture course in this subject comprises the theory and adjustment of the instruments used in connection with a geodetic survey; the methods of taking and reducing observations for time, longitude, latitude, and azimuth. with the precision required on such a survey; and other matters relating to these subjects.

75. Geodesy and Metrology. W. M. Treadgold.

Department 1b, IV Year; 2 hrs. per week, both terms.

The lecture course includes a description of the methods of measuring base lines and the angles of a triangulation; the geometry of the spheroid with applications to geodetic problems; the computation of geodetic positions; the solution of large triangles on the earth's surface, and the adjustment of a triangulation; trigonometric and precise spirit levelling; the determination of the figure of the earth by arc measurements, and by the pendulum; the theory of map projections, etc.

76. Astronomy, Geodesy and Metrology. W. M. Treadgold, J. W. Melson.

Department 1b, IV Year; about 23 hrs. per week, both terms.

The practical work in the above subjects includes the observation of meridian transits for time and longitude determinations, and of prime vertical transits for latitude, with the astronomical transit instrument; the observation of meridian zenith distances of stars, and of azimuths at elongation for latitude, with the alt-azimuth; theodolite observations for azimuth; observations for latitude with the zenith telescope; the investigation of the constants of the instruments used, and the reduction of all observations; the measurement of a base line with the steel tape and with invar wires, and the determination of the constants of the tape; the measurements of the angles of a triangulation and the adjustment of the angles of network of triangles, etc. A portion of this work will be taken at the University Survey Camp. (See course 275.)

BIOLOGY

80. Elementary Biology. A. J. V. Lehmann.

Department 6, I Year; 3 hrs. per week, second term.

A lecture and laboratory course on biological principles.

CHEMISTRY

84. General Chemistry. E. G. R. Ardagh, E. A. Smith.

Departments 1, 2, 3 and 7, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

An advanced course in inorganic chemistry with industrial applications.

85. General Chemistry. E. G. R. Ardagh, E. A. Smith.

Departments 5, 6 and 8, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

An advanced course in inorganic chemistry with industrial applications.

86. Inorganic Chemistry. L. J. Rogers.

Department 5, I Year; 3 hrs. per week, both terms.

Department 6, I Year; 12 hrs. per week, both terms.

A laboratory course of quantitative experiments illustrating the use of the sensitive balance, and confirming the fundamental laws of chemistry; qualitative inorganic analysis; quantitative analysis of pure salts.

Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

87*a*. Inorganic Chemistry A. E. G. R. Ardagh.

Departments 1, 2, 3, 6, 7 and 8, II Year; 1 hr. per week, first term.

A continuation of courses 84 and 85 dealing principally with the metals.

87*b*. Inorganic Chemistry B. E. G. R. Ardagh.

Departments 2, 6 and 8, II Year; 1 hr. per week, second term.

A continuation of courses 84 and 85.

Text book: General Chemistry—Deming.

88. Analytical Chemistry. L. J. Rogers.

Departments 2, 6 and 8, III Year; 1 hr. per week, both terms.

A lecture course on the principles of chemical analysis; select gravimetric and volumetric methods; technical analysis.

89. Analytical Chemistry. E. A. Smith, R. R. McLaughlin.

Departments 1 and 3, II Year; 6 hrs. per week, second term.

Department 2, II Year; 6 hrs. per week to Dec. 1st.

Department 7, II Year; 6 hrs. per week, first term.

Laboratory course in qualitative and quantitative analysis.

90. Analytical Chemistry. E. A. Smith.

Department 2, II Year; 6 hrs. per week, from Dec. 1st.

A laboratory course in the gravimetric determination of metals and acids, with elementary volumetric analysis.

91. Analytical Chemistry. L. J. Rogers.

Department 8, II Year; about 14 hrs. per week, first term; about 13 hrs. per week, second term.

A laboratory course comprising gravimetric and volumetric methods, acidimetry and alkalimetry.

Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

92. Analytical Chemistry. L. J. Rogers.

Department 6, II Year; about 100 hrs., to Dec. 1st.

A laboratory course in quantitative chemical analysis; inorganic preparations.

Text book: Analytical Chemistry, Vol. II—Treadwell-Hall.

93. Engineering Chemistry. J. W. Bain.

Departments 1, 3, 5, 6 and 7, II Year; 1 hr. per week, first term.

A lecture course consisting of a study of the industrial production and application of heat, and of the chemistry of fuel and the products of combustion.

94. Industrial Chemistry. J. W. Bain.

Department 6, II Year; 1 hr. per week, both terms.

A lecture course on the manufacture of salts, acids, alkalies and inorganic chemicals.

94*a*. Industrial Chemistry and Technical Analysis. E. G. R. Ardagh.

Department 6, II Year; about 70 hrs., second term.

An introductory laboratory course in industrial chemistry containing experiments on petroleum products, fertilizers, etc., preparation of inorganic salts on a pound scale.

95. Organic Chemistry. M. C. Boswell.

Departments 1, 3 and 7, II Year; 1 hr. per week, second term.

A lecture course upon some of the elementary principles of Organic Chemistry and their application to selected industries.

96. Industrial and Laboratory Synthesis in Organic Chemistry. M. C. Boswell.

Department 6, II Year; 2 hrs. per week, both terms.

A discussion of the chemical reactions used in synthesis in the laboratory and the factory, and of the conditions under which compounds are brought into reaction, the conditions used for securing high yields, and the methods employed for isolating compounds from reaction mixtures both in the laboratory and in industry.

97. Industrial and Laboratory Methods of Synthesis. M. C. Boswell, R. R. McLaughlin.

Department 6, II Year; about 115 hrs., second term.

A laboratory course accompanying lecture course 96.

98. Physical Chemistry. F. B. Kenrick.

Departments 5 and 6, II Year and Department 8a, III Year; 2 hrs. per week, both terms.

A course of lectures on the elements of chemical mechanics, and the theory of solutions.

99. Analytical Chemistry. L. J. Rogers.

Department 2, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.

A laboratory course on the technical analysis of ores and furnace products.

100. Industrial Chemistry and Technical Analysis. E. G. R. Ardagh.
Department 6, III Year; 155 hours.

A continuation of laboratory course 94a, containing experimental work on coal, petroleum, illuminating gas, silicates, sugars, starch, etc., potentiometric determination of hydrogen-ion, preparation of inorganic salts on a pound scale. Instruction in glass blowing is given in this course.

Text book: American Society for Testing Materials. Engineering Chemistry—Stillman. Liquid and Gaseous Fuels—Lewes and Kershaw. Fuels and their Combustion—Haslam and Russell. Determination of Hydrogen Ions—Clark. Technical Methods of Chemical Analysis—Lunge. Handbook for Cane Sugar Manufacturers—Spencer.

101. Analytical Chemistry and Phase Rule. L. J. Rogers, J. T. Burt-Gerrans.
Department 8, III Year; about 6 hrs. per week, second term.

A laboratory course in analysis and phase rule.

102. Engineering Chemistry. J. W. Bain, E. G. R. Ardagh.
Departments 1, 2, 3, 6, 7, 8 and 8a, III Year; 1 hr. per week, both terms.

A lecture course on the application of chemistry to engineering problems: air, water, corrosion of metals, explosives, petroleum products, rubber, synthetic resins, etc.

103. Industrial Chemistry. E. G. R. Ardagh.
Department 6, III Year; 1 hr. per week, both terms.

A lecture course on petroleum and its products, coal tar and its products, fats, oils, soap, sugar, starch, rubber, fermentation industries, etc.

104. Chemical Plant. J. W. Bain.
Department 6, III Year; 1 hr. per week, both terms.

A lecture course on the machinery and plant used in chemical manufacturing.

104*a*. Chemical Engineering. Staff in Chemical Engineering.
Department 6, III Year.

A laboratory course in Chemical Engineering introductory to Course 111.

105. Industrial and Laboratory Synthesis in Organic Chemistry. M. C. Boswell.
Department 6, III Year; 2 hrs. per week, both terms.

A continuation of Lecture Course 96.

106. Industrial and Laboratory Methods of Synthesis in Organic Chemistry. M. C. Boswell, E. A. Smith, R. R. McLaughlin.

Department 6, III Year; 125 hrs.

Laboratory and industrial reactions are performed, in some cases using the following small scale industrial apparatus: filter press, sulphonator, tanks for precipitation, electric stirrer, vacuum evaporator, vacuum drier, fusion pot, ball mill, high pressure autoclaves, pumps for transferring liquids, and materials for constructing electric tube furnaces and thermocouples.

Text book: Manual of Industrial Chemistry (Organic)—Rogers. Practical Methods of Organic Chemistry—Gattermann. Unit Processes in Organic Synthesis—Groggins. Die Methoden der organischen Chemie—Houben-Weyl.

107. Electrochemistry. W. L. Miller, J. T. Burt-Gerrans.

Departments 6, 7 and 8, III Year; 2 hrs. per week, first term.

A lecture course on elementary electrochemistry, illustrated by experiments.

108. Electrochemistry. W. L. Miller, J. T. Burt-Gerrans.

Departments 6, 7 and 8, III Year; 3 hrs. per week, first term.

A laboratory course in quantitative measurements to accompany course 107.

109. Inorganic Chemistry. J. W. Bain.

Department 6, IV Year; 2 hrs. per week, both terms.

A lecture course on chemical theory.

110. Catalysis in Organic Chemical Industry. M. C. Boswell.

Department 6, IV Year; 1 hr. per week, both terms.

This lecture course is a continuation of Courses 96 and 105 and embraces as well a discussion of the methods used in several of the industries employing catalysts.

110a. Organic Chemistry. M. C. Boswell.

Departments 5s and 5g, III Year; 1 hr. per week, both terms.

A lecture course on the general reactions and methods of synthesis of carbon compounds.

Text book: Organic Chemistry—Perkin and Kipping.

111. Chemical Engineering and Industrial Organic Chemistry. Staff in Chemical Engineering.

Department 6, IV Year.

A laboratory course involving quantitative measurements employing the following standard apparatus: still, heat interchanger, absorption column, and filter press. The experiments have been selected to furnish experimental data for the confirmation of some of the principles and mathematical expressions discussed in Lecture

Course 104. The course also includes experiments in industrial chemistry supplementary to Course 106.

Text books: Lewis and Randall—Thermodynamics. Principles of Chemical Engineering—Walker, Lewis and McAdams. Distillation Principles and Processes—Sydney Young.

112. Industrial Chemistry. J. W. Bain.

Department 6, IV Year; 1 hr. per week, both terms.

A lecture course on selected subjects in chemical technology.

113. Research. The senior staff in Chemical Engineering.

Department 6, IV Year.

In this course, which occupies about three-quarters of the total time of the year, a research problem is given to each student. This provides experience in searching the primary sources of scientific information and in devising analytical methods and designing apparatus applicable to the new problems. Each student is obliged to write a thesis embodying the results of his search of the original literature and his own experimental work. Thus this course serves as a preparation for the field of research work; and those students who, by ability, taste, and temperament, are fitted for research pass naturally either into industrial research or into the graduate school of the University to pursue further work in this field.

114. Electrochemistry. J. T. Burt-Gerrans.

Department 6e, 7e, and 8, IV Year; 2 hrs. per week, both terms.

An advanced lecture course on the theory of solutions and electrolysis, and the application to the practice of electro-deposition and electrolytic refining of metals. The course also includes lectures on the electric furnace with special consideration of efficiency.

Reference books: Electrometallurgy—Borchers. Electrochemistry—Le Blanc. Electrochemistry—Luepke. Principles of Applied Electrochemistry—Allmand and Ellingham. The Electric Furnace—Stansfield. The Electric Furnace—Pring.

115. Electrochemistry. J. T. Burt-Gerrans.

Departments 6e, 7e and 8, IV Year.

A laboratory course accompanying course 114.

116. Sanitary and Forensic Chemistry. J. W. Bain.

Department 6, IV Year; 1 hr. per week, both terms.

A lecture course on the composition and examination of air, water and food; poisons and their detection, with accompanying laboratory course.

116*a*. Silicate Chemistry. J. B. Ferguson.

Department 8a, IV Year; 2 hrs. per week, first term.

The application of phase rule to the chemistry of refractory materials.

ECONOMICS AND BUSINESS ADMINISTRATION

121. Business. R. R. Grant.

Departments 1, 2, 3, 6, 7, 8, I Year; 1 hr. per week, second term.

A lecture course on the principles underlying accounting and general business methods of a simple nature in order to enable the student to understand simple financial reports.

122*a*. Technical English. W. J. T. Wright.

Departments 1, 2, 3, 4, 6, 7 and 8, I Year; 1 hr. per week, both terms.

A lecture course on the expression of ideas and the compilation and writing of engineering reports and letters; technical exposition; the necessity of accurate expression in professional writing; the value of reading.

122*b*. English. W. J. T. Wright.

Department 4, II Year; 1 hr. per week, both terms.

This course of lectures includes a discourse on the literature which refers either directly or indirectly to architecture and the arts. Books are reviewed and discussed in round-table talks.

123. Economics and Finance. C. H. Mitchell.

Departments 1, 2, 3, 4, 6, 7 and 8, II Year; 1 hr. per week, both terms.

An introduction to the study of Economics. The course will deal in an elementary manner with the following:

(1) Scope of Economics.
(2) Economic Geography.
(3) Theory of Value, Supply and Demand.
(4) Theory of Production and Distribution.
(5) Structure of Industry and Social Conditions.
(6) Money, Banking and Finance.
(7) Economics of Canada with special reference to the relation of Engineering to Finance.

Text books: Economics for the General Reader—Clay. Supply and Demand—H. D. Henderson. Annual Financial Reviews.

124. Commercial Law. F. C. Auld.

Departments 4 and 7, III Year; Department 8a, IV Year; 1 hr. per week, both terms.

General Principles of the Law of Contracts, Principal and Agent, Partnership and Limited Companies with special reference to the Companies Acts. General view of the following:—Negotiable Instruments, Sale of Goods, Bills of Sale and Chattel Mortgages, Suretyship and Guarantee.

Text book: Falconbridge and Smith—Manual of Canadian Business Law.

125. Engineering Economics. C. R. Young.

Departments 1, 2, 3, 5c, 5s, 7 and 8, IV Year; 1 hr. per week, second term.

A series of lectures on the principles by which the economic practicability of a project is judged and the comparison of competing proposals is made. Consideration is given to first cost and annual cost, methods of estimating, fixed charges and operating expenses, financing of engineering projects, valuation and appraisals. Special attention is given to depreciation and the methods of providing for it. Typical numerical problems are discussed and solved.

Text books: Engineering Economies—Fish. Financial Engineering—Goldman. Principles of Engineering Economy—Grant.

126. Engineering Law. R. E. Laidlaw.

Department 1, IV Year; 1 hr. per week, first term.

A course of lectures, co-ordinating Engineering practice and Law as contained in various legislation such as: The Railway Act, Municipal Act, Public Health Act, Arbitration Act, Workmen's Compensation Act, Patents, Copyrights, etc.

127. Contracts and Specifications. C. R. Young.

Departments 1, 4, 8, and 8a, IV Year; 1 hr. per week, second term.

This course of lectures deals with the fundamental principles of contract and specification writing. The critical examination of typical specifications and agreements by the class, forms an essential feature of the instruction.

Text book: Elements of Specification Writing—Kirby.

128. Management. C. R. Young.

Department 1, IV Year; 1 hr. per week, first term.

A series of lectures dealing with the fundamental principles upon which management is based. The possibilities of effective management are indicated and its basis is shown to exist in suitable organization, adequate equipment and smooth administration.

Text books: Construction Cost Keeping and Management—Gillette and Dana. Principles of Industrial Organization—Kimball. Principles of Industrial Management—Allcut.

129. Plant Management. G. A. Guess.

Department 8 and 8a, IV Year; 1 hr. per week, second term.

A course of twelve lectures dealing with some phases of labour, plant organization, smelter contracts and markets.

130. Industrial Management. E. A. Allcut.

Departments 3, 6 and 7, IV Year; 1 lecture per week, both terms.

This course includes a study of industrial organization, location, arrangement, construction and equipment of industrial plants for

efficiency and economy, process routing, scheduling work, reports, methods of superintending, employment, systems of compensating labour and systems of distributing indirect expenses.

Text book: Principles of Industrial Management—Allcut.

131. Municipal Administration. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. per week, second term.

A lecture course dealing with municipal government, assessment and taxation, municipal finance, public utilities, expropriation, annexation problems, town planning, local improvement and other laws relating to municipalities.

133. Public Speaking. F. H. Kirkpatrick.

Department 1, II Year, 1 hr. per week, second term.

Department 4, III Year; 1 hr. per week, first term.

A course on the principles of public speaking and the means of expression, accompanied by practical application and training in actual speaking.

ELECTRICITY

135. Electricity. H. W. Price.

Departments 1, 2, 3, 5, 6, 7 and 8, I Year; 2 hrs. per week, both terms.

A course of lectures on basic principles relating to electric circuits, magnetic circuits, instruments and apparatus in general, distribution of electrical energy, etc., illustrated largely from commercial apparatus. The point of view of this work is quantitative rather than descriptive, for it is believed that men who can solve engineering problems are most likely to grasp underlying principles.

136. Electricity. V. G. Smith.

Departments 3, 5, 6, 7 and 8; II Year; 2 hrs. per week, both terms.

A course of lectures on the general principles and calculation of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power and energy. The principles underlying commercial instruments are considered together with the methods of calibration.

Reference Books: Electrical Measurements—Laws. Electrical Measurements in Theory and Application—Smith. Electrical Measurements and Measuring Instruments—Golding.

137. Electrical Laboratory. V. G. Smith.

Departments 3, 6, 7 and 8; II Year; 3 hrs. per week, both terms.

Department 5, II Year; 3 hrs. per week, first term.

The more important methods of measurement of resistance, current, potential difference, inductance, and capacity are used, often under conditions such as occur in practice. The principles of

measurement are applied to other problems such as the location of line faults and the measurement of temperature rise by resistance changes. Methods of calibrating commercial instruments are also included.

138. Magnetism and Electricity. A. R. Zimmer.

Department 3, III Year; 1 hr. per week, both terms.

Departments 5 and 7, III Year; 2 hrs. per week, first term; 1 hr. per week, second term.

A course of lectures on theory of magnetism and magnetic circuits, theory of direct-current generators, motors, etc.

Reference Books: Electrical Engineering, Vol. I—Dawes. Electrical Circuits and Machinery, Vol. I—Morecroft and Hehre. Electricity and Magnetism for Engineers, Part I—Pender. Principles of D.C. Machines—Langsdorf. Direct-Current Machinery—Pender. Electrical Engineering—Christie. Elements of Electrical Engineering—Cook. D. C. Machinery—Kloeffler, Brenneman and Kerchner.

139. Alternating Current. A. R. Zimmer.

Departments 3, 5h and 5e, III Year; 1 hr. per week, both terms.

Departments 5c, 5s, 5g, 5i and 7, III Year; 1 hr. per week, first term; 2 hrs. per week, second term.

A first course of lectures on alternating current, covering principles of measurement and leading to the analytical and graphical treatment of the simpler problems relative to alternating-current circuits and machinery.

Reference Books: Electricity and Magnetism for Engineers, Part II—Pender. Electrical Engineering—Christie. Electrical Engineering, Vol. II—Dawes. Electrical Circuits and Machinery, Vol. II—Morecroft and Hehre. Alternating Current Electrical Engineering—Maccall. Alternating Current Electrical Engineering—Kemp. Elements of Electrical Engineering—Cook.

140. Electrical Laboratory. A. R. Zimmer.

Department 3, III Year; 4½ hrs. per week first term, 3 hrs. per week second term.

Departments 5c, 5s, 5g, 5i and 7, III Year; 6 hrs. per week, both terms.

Departments 5h and 5e, III Year; 3 hrs. per week, both terms.

This laboratory course is intended to afford the student an opportunity to become familiar with principles involved in continuous-current shunt, series and compound-wound generators and motors; and, to some extent, alternating-current circuits and machinery. Other sections of the work deal with the magnetic properties of iron and steel, and study of iron losses in transformers and generators.

The course is arranged to stand in close relation to the lecture

courses in the subjects of magnetism and electricty and alternating current (courses 138 and 139) for III Year, and to certain design work (course 141).

141. Electrical Design. H. W. Price.

Departments 5c and 7, III Year; 1 hr. per week, both terms.

A course of lectures dealing with design of electrical apparatus and machinery, accompanied by designs to be worked out in the design room.

142. Electrical Design Laboratory. H. W. Price.

Department 7, III Year; 3 hrs. per week, both terms.

A design room is set apart for working out designs of electrical apparatus such as transformers, generators, motors, auxiliary apparatus, etc.

Special forms and notes are employed, arranged to suit the various studies. Certain models are provided to assist where necessary.

143. Electricity. H. W. Price.

Departments 6, 8 and 8a, III Year; Departments 1 and 2, II Year; 1 hr. per week, both terms.

A course of lectures dealing with fundamental calculations of alternating current circuits and various applications of interest to those who are not making electricity a major subject.

144. Electrical Laboratory. H. W. Price, A. R. Zimmer.

(*a*) Department 1, II Year; 3 hrs. per week, second term; Department 2, IV Year, 3 hrs. per week, first term.

(*b*) Departments 6 and 8a, III Year; 3 hrs. per week, second term.

(*c*) Department 8, III Year; 3 hrs. per week, both terms.

These courses are arranged to suit the requirements of the departments concerned. The experiments are planned with the idea of affording a general knowledge of circuits, power measurements, direct-current and alternating-current machinery and transmission of power.

Reference Books: Elements of Electrical Engineering—Cook.

145*a*. Applied Electricity. V. G. Smith.

Symbolic and Graphical Methods.

Departments 5c and 7, IV Year; 2 hrs. per week, both terms.

Complex quantities and their use in a.c. problems. Loci for current and voltage vectors for given limitations on circuit constants. Short line distribution circuit loci; approximate graphical theory of synchronous motor.

Reference Books: Principles of Alternating Currents—Lawrence. Alternating Current Circuits—Weinbach.

145*b*. Applied Electricity. V. G. Smith.

Wave Form and Transmission Line.

Departments 5c and 7, IV Year; 1 hr. per week, both terms.

Non-sinusoidal alternating current waves, analysis of waves, forms of symmetry, three phase limitations, elimination of undesired harmonics, heating of rotary converters; power, current, and voltage readings as influenced by wave form.

145*c*. Applied Electricity. H. W. Price.

Alternating Current Machinery and Measurements.

Department 7, IV Year; 2 hrs. per week, both terms.

Polyphase alternating-current measurements of power, reactive power, apparent power, finding the indications of meters from given wiring diagrams, constructing wiring diagrams to obtain required meter indications. Potential and current transformers. Meter indications with distorted wave forms. Power transformers. Properties of alternators; induction motors of squirrel cage and wound-rotor types; synchronous motors; regulators; current-limiting reactors; arresters; and other general apparatus.

146. Electrical Laboratory. A. R. Zimmer.

Department 5c, IV Year; 6 hrs. per week, both terms; Department 7, IV Year; 20 hrs. per week, both terms; in connection with Course 145.

This laboratory course involves a thorough study of principles and properties of single-phase and polyphase circuits and apparatus. Both vector and analytical methods are applied to the solution of problems based on tests made on laboratory machines.

The work deals mainly with constant-voltage and constant-current transformers, single and polyphase alternators, synchronous motors, rotary converters, induction and single-phase commutating motors, transmission line, etc. The work does not consist only of factory tests, but is designed to lead the student to apply theory to practice as illustrated in the apparatus under test, with a view to an exact understanding of methods and an appreciation of limitations under many conditions. Free use is made of the oscillograph as a necessary device for "seeing" conditions under investigation. The best commercial measuring instruments are available.

Reference Books: Electrical Engineering—Christie. Experimental Electrical Engineering, Vols. I and II—Karapetoff. Principles of A.C. Machinery—Lawrence. A.C. Machinery—Bryant and Johnson.

147. Radiotelegraphy. B. de F. Bayly.

Departments 5c, 5s and 7r, IV Year, in connection with course 148; 2 hrs. per week, both terms.

Natural oscillations of simple and simply coupled circuits. Action of C.W. on circuits of the most general character. Radiation of antennas. Theory of modulation in radiotelephony. Energy control and transformation by vacuum tubes.

Reference Books: Differential Equations for Electrical Engineers —Franklin.

148. Radiotelegraph Laboratory. B. de F. Bayly.

Departments 5c and 5s, IV Year; 6 hrs. per week, both terms; Department 7r, IV Year; 9 hrs. per week, both terms; in connection with Course 147.

The work in this laboratory covers the principles and the technique of measurements at radio frequencies. This includes measurements of wave length, resonance, coupled circuits, inductance, capacity, energy distribution, resistance, etc., at radio frequencies.

Considerable work is also done with the three electrode vacuum tube and its uses in radio and audio-frequency circuits.

Reference Books: Communication Engineering—Everitt. Alternating Current Bridge Methods—Hague. High Frequency Measurements—Hand.

149. Acoustics. B. de F. Bayly.

Departments 5c, 5s and 7r, IV Year; 1 hr. per week, first term.

The principles of recording, transmission, and reproduction of sound in connection with electrical systems. Mechanical vibrating systems; microphones; loud speakers; causes of distortion; principles of hearing; reverberation.

Reference Books: Elements of Engineering Acoustics—Hughes. A Text Book of Sound—Wood. Acoustics—Stewart and Lindsay.

150. Thermionic Tubes. B. de F. Bayly.

Departments 5c and 5i, III Year; 1 hr. lecture per week, both terms, 3 hrs. laboratory per week, second term.

The basic principles of operation and construction of thermionic tubes of both the high vacuum and gaseous types.

151. Applications of Thermionic Tubes. B. de F. Bayly.

Department 5i, IV Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

The various fundamental circuits using thermionic tubes are given, including their applications.

152. Operational Calculus. V. G. Smith.

Departments 5c, 5s, 5e and 5i, IV Year; 2 hrs. per week, both terms.

Operational methods before Heaviside. Operators of electric circuits. Series expansions. Useful rules concerning shifting and transfer operations, differentiation and integration with respect to

parameters. The Heaviside Expansion Theorem. Duhamel's theorem and Carson's integral. Campbell and Foster's mates and other tables. Evaluation by contour integration. Borel's theorem.

Reference books: Electromagnetic Theory—Heaviside. Operational Circuit Analysis—Bush. Electric Circuit Theory and the Operational Calculus—Carson. Heaviside's Operational Calculus—Berg. Fourier Integrals for Practical Applications—Campbell and Foster.

153. Electromagnetic Theory. V. C. Smith.

Departments 5c, 5s, and 5g, IV Year; 2 hrs. per week, both terms.

The principles of electromagnetism. Magnetic fields from currents in the neighbourhood of feromagnetic bodies. Electromagnetic waves guided by wires, their attenuation and reflection. Skin effects. Plane waves in space, their reflection and refraction. Cylindrical and spherical waves. Radiation from antennas.

Reference books: Electromagnetic Theory—Heaviside. Electricity and Magnetism—Jeans. Electro-Magnetic Problems in Electrical Engineering—Hague. Classical Electricity and Magnetism—Abraham-Bocker.

ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY

160. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3, 5, 6, 7 and 8, I Year; 1 hr. per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solutions of problems relating to straight lines and planes.

161. Descriptive Geometry. J. R. Cockburn.

Department 4, I Year; 1 hr. per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solution of problems relating to straight lines and planes, special reference being made to the determination of shades and shadows.

162. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3 5, and 7, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of the work taken in the First Year with the following additions: problems relating to curved surfaces, principles of shades, shadows and perspective.

163. Descriptive Geometry. J. R. Cockburn.

Department 4, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of the work taken in the First Year with the addition of problems relating to curved surfaces, shades, shadows and perspective.

164. Descriptive Geometry. J. R. Cockburn.

Department 1, III Year; 1 hr. per week, first term.

This course of lectures deals with spherical projections, the principles of mapmaking, and the graphical solution of spherical triangles.

166. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Department 1, I Year, 10 hrs. per week, first term, 17 hrs. per week, second term; Department 2, I Year, 9 hrs. per week, first term, 12 hrs. per week, second term; Department 3, I Year; 9 hrs. per week, first term; 15 hrs. per week, second term; Department 7, I Year; 12 hrs. per week, first term, 17 hrs. per week, second term; Department 8, I Year; 11 hrs. per week, first term, 18 hrs. per week, second term.

Copying from the flat, lettering, topography; graphical solution of problems in statics; problems in descriptive geometry, relating to both orthographic and oblique projections; the plotting of original surveys; measured drawings.

167. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Department 4, I Year.

Lettering, the graphical solution of problems in statics; problems in descriptive geometry, relating to both orthographic and oblique projections; measured drawings.

168. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Department 6, I Year; 2 hrs. per week, first term; 3 hrs. per week, second term.

Copying from the flat, lettering, graphical solution of problems in statics, problems in descriptive geometry.

169. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Departments 1 and 2, II Year. Department 1, 5 hrs. per week, first term; 10 hrs. per week, second term; Department 2, 3 hrs. per week, first term; 10 hrs. per week, second term.

Colouring and shading as applied to both topographical and construction drawings; problems in descriptive geometry relating to solids bounded by curved surfaces; principles of shades, shadows and perspective; solution of problems in optics and strength of materials; measured drawings; elementary design.

170. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.

Departments 3 and 7, II Year; Department 3, 14 hrs. per week, first term; 6½ hrs. per week, second term; Department 7, 9½ hrs. per week, first term; 14½ hrs. per week, second term.

Colouring and shading as applied to construction drawings; problems in descriptive geometry relating to solids bounded by curved surfaces; principles of shades, shadows and perspective; solution of problems in optics, theory of mechanism and strength of materials; measured drawings; elementary design.

171. Engineering Drawing. J. R. Cockburn.
Department 4, II Year.
Principles of shades, shadows and perspective; problems in descriptive geometry relating to solids bounded by curved surfaces; solution of problems in strength of materials.

172. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.
Department 6, II Year; 7 hrs. per week, first term; 3 hrs. per week, second term.
Department 8, II Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

173. Engineering Drawing. W. B. Dunbar.
Department 1, III Year; 13 hrs. per week, first term; 14 hrs. per week, second term.
Principles of mapmaking, spherical projection; problems in theory of construction; original design of various structures.

174. Engineering Drawing. W. B. Dunbar.
Department 2, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.
Problems in theory of construction; original design.

177. Engineering Drawing. W. B. Dunbar.
Departments 3, 5, 6 and 8a, III Year; Department 3, 6 hrs. per week, first term; 3 hrs. per week, second term; Departments 5h and 6, 3 hrs. per week, both terms; Department 5e, 6 hrs. per week, first term; 9 hrs. per week, second term; Department 8a, 6 hrs. per week, first term; 3 hrs. per week, second term.
Problems in design dealing with the theory of structures.

178. Structural Design Drawing. W. J. Smither.
Department 1 (a), IV Year; 15 hrs. per week, both terms.
Problems in structural design.

180. Structural Design Drawing. W. J. Smither.
Department 3, IV Year; 3 hrs. per week, first term.
Problems in mill building design.

182. Engineering Drawing. W. B. Dunbar.
Department 8, III Year; 3 hrs. per week, first term.
Plotting metallurgical flow sheets.

183. Structural Design Drawing. W. J. Smither.
Department 8 (a), IV Year; 6 hrs. per week, both terms.
Of this time half in the first term is devoted to problems in mill building design bearing on lecture course 18. The remainder of the time in the first term and the whole time in the second term is devoted to the original design of ceramic plants, driers, kilns, etc.

184. Engineering Drawing. J. R. Cockburn, W. J. T. Wright.
Department 5, I Year; 3 hrs. per week, first term; 6 hrs. per week, second term.
The graphical and analytical solution of problems involving descriptive geometry, applied mechanics and mathematics.

APPLIED PHYSICS

185*a*. Applied Physics. The Staff in Applied Physics.
Departments 3 and 7, I Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.
A course of lectures with laboratory work on the production and distribution of light, photometry and illumination, optics and optical instruments.

185*b*. Optics. K. B. Jackson.
Department 6, I Year; 1 hr. lecture per week, both terms, 3 hrs. laboratory per week, first term.
A course of lectures with laboratory work on light, geometrical and physical optics, and optical instruments.

186. Applied Physics Laboratory. The Staff in Applied Physics.
Department 6, II Year; 1 hr. laboratory per week, second term.
A short laboratory course supplementing 185b in Optics and course 212 in Hydrostatics.

187. Applied Physics. The Staff in Applied Physics.
Department 1, I Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.
A course of lectures and laboratory work on optics and optical instruments, the projection of light and its applications in marine and railway signalling, flood lighting, etc.

188. Photography. K. B. Jackson.
Department 4, II Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.
A course of lectures with laboratory work on the principles of photography, photographic equipment, materials, and processes, with special reference to architectural photography and an outline of the photo-mechanical processes.

188*a*. Photography Applied to Research. K. B. Jackson.
Senior and graduate students; 1 hr. lecture, 2 hrs. laboratory per week, both terms.
A course of lectures with laboratory work on the principles of photography, the choice and use of equipment for special purposes, the photometry of projection, sensitometry and the correct use of photographic materials and processes.

189. Photographic Surveying. K. B. Jackson, W. M. Treadgold.

Department $1a_3$, IV Year; 3 hrs. lectures per week, first term; 2 hrs. lectures per week, second term; 3 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the photographic processes involved, the calibration of surveying cameras, the stereoscopic examination of photographs, and methods of plotting in ground and aerial photographic surveying.

189*a*. Photographic Surveying. K. B. Jackson, W. M. Treadgold.

Department 1b, IV Year; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

A short course of lectures with laboratory work on the subject matter of course 189.

190. Light and Sound. The Staff in Applied Physics.

Department 4, III Year; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

An elementary course of lectures with laboratory work on the production, distribution, and measurement of light, sound, and electricity in preparation for course 191.

191. Acoustics and Illumination Design. K. B. Jackson.

Department 4, IV Year; 1 hr. lecture, 1 hr. laboratory per week, both terms.

A course of lectures with laboratory work on architectural acoustics, the properties and uses of acoustical materials, and the design of lighting installations for public and private buildings.

191*a*. Architectural Acoustics. K. B. Jackson.

Department 5i, IV Year; 2 hrs. lecture, 6 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the design of buildings for good acoustics, on the calculation and measurement of the acoustical properties of buildings and materials, and on the treatment of buildings to improve their acoustical properties and to control the nuisance of noise.

192. Photometry. K. B. Jackson.

Department 7i, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, first term; 1 hr. lecture, 3 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the production, distribution, and measurement of light and colour, the theory and application of visual and physical photometers, and the photometry of projection equipment.

192*a*. Illumination Design. K. B. Jackson.

Department 7i, IV Year; 1 hr. lecture, 6 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the theory and design of lighting equipment and installations.

192*b*. Photometry and Illumination Design. K. B. Jackson.

Department 5i, IV Year; 2 hrs. lecture, 6 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on measurements of luminous intensity, luminous flux, illumination, brightness, reflection, transmission, absorption, diffusion, and colour by visual and physical methods; and on the design and application of illuminating engineering equipment.

GEOLOGY

193. Field Work. E. S. Moore.

Department 2, III Year; one week at the University Survey Camp preceding the opening of the first term.

194. Pleistocene Geology and Physiography. A. MacLean.

Departments 2 and 8a, IV Year; 1 hr. per week, both terms.

Pleistocene Geology. Lectures on the formation and distribution of the drift deposits of North America, with brief references to other regions. Glacial, interglacial, and postglacial beds are described, changes of climate are discussed with their probable causes, and the economic features of the clays, sands, and gravels are considered.

Physiography. A course of lectures on the surface forms of the earth, and on the geological factors that have produced them. The broad features of the earth, its plains, tablelands, hills, valleys, mountains, oceans, rivers, and lakes are discussed in a general way; methods of topographical surveying and mapping are referred to, and the chief physiographic areas of Canada are described.

Works of reference: Ice Ages, Recent and Ancient—Coleman. Physiography—Salisbury.

195. Elementary Geology. J. Satterly.

Departments 1 and 2, II Year; Department 5g, IV Year; 2 hrs. per week, second term.

This course deals chiefly with historical geology with special reference to Canadian formations.

Works of reference: Introduction to Geology—Scott. Elementary Geology—Coleman and Parks.

196. Geology and Ore Deposits. J. Satterly.

Department 8, II Year; 2 hrs. per week, both terms.

Lectures and laboratory work on historical, structural, and economic geology, designed to familiarize the student with the more important principles, facts, and terms of general geology.

Works of reference: As in course 195.

197. Engineering Geology. A. MacLean.

Departments 1 and 8a, III Year; 1 hr. per week, both terms.

This course deals with the application to engineering of dynamic, structural, and economic geology.

Works of reference: Engineering Geology—Ries and Watson.

198. Dynamic and Structural Geology. A. MacLean.

Department 2, II Year; Department 5g, IV Year; 1 hr. per week, first term.

Lectures on geological forces and their effects. Particular attention is given to those aspects of the subject that apply in mining.

Works of reference: Geology—Emmons, Thiel, Stauffer and Allison.

199. Precambrian Geology. E. S. Moore.

Departments 2 and 5g, IV Year; 2 hrs. per week, first term.

Lectures on the Precambrian formations of Canada—their rocks, distribution, relationships, and economic features. Briefer accounts are given of similar formations in the United States and elsewhere.

Works of reference: Reports of the Geological Survey of Canada and of the Ontario Department of Mines. Reports of the United States Geological Survey.

200. Mining Geology. E. S. Moore.

Departments 2 and 5g, IV Year; 2 hrs. per week, second term.

A course of lectures on geological problems associated with mining, typical mining regions in Canada, the United States, and elsewhere being discussed from the geological side.

Works of reference: Mineral Industry. Geology Applied to Mining—Spurr; and the works mentioned under course 199.

201. Geological Excursions. A. MacLean.

Departments 2 and 8a, IV Year.

During October weekly trips will be made to points of interest near Toronto.

202. Economic Geology. E. S. Moore.

Department 2, III Year; Department 5g, IV Year.

(*a*) Ore Deposits: 1 hr. per week, both terms.

Discussion of the origin and classification of ore deposits, the mode of occurrence of the chief ores, and statistics of production. Special attention is given to the metals mined in Canada.

(*b*) Economic Geology of the Non-metals: 2 hrs. per week, second term.

Lectures on the origin and mode of occurrence of the valuable non-metallic substances—coal, oil, building stone, gypsum, cement materials, etc.

Works of reference: Economic Geology—Ries. General Economic Geology—Emmons. Coal—Moore. Practical Oil Geology—Hager. Mineral Resources of Canada—Moore. Introduction to the Study of Ore Deposits—Hatch.

203. Economic Geology. E. S. Moore.

Department 2, III Year; 2 hrs. per week, second term.

Laboratory work on ores, manner of occurrence, vein structure, etc., also the examination and construction of geological maps and sections of typical mining regions.

203*a*. Economic Geology. E. S. Moore.

Department 5g, IV Year; 3 hrs. per week, both terms.

Laboratory work on ores, geological features of mining areas, interpretation of drill logs, geological maps, and structure sanctions.

203*b*. Location of Mineral Deposits. E. S. Moore.

Department 5g, IV Year; 2 hrs. per week, second term.

Geological features and principles involved in the application of geophysical methods in the search for mineral deposits, and the interpretation of the structure of the earth's crust.

204. Building Stones. E. S. Moore.

Department 4, IV Year; 1 hr. per week, first term.

Department 4, V Year; 1 hr. per week, first term (1936-37 only).

Lectures and laboratory work on decorative and structural stones used in building; their properties, sources, extraction, and preparation for use in buildings.

HYDROSTATICS AND HYDRAULICS

205. Hydraulics. R. W. Angus.

Departments 1, 2, 3, 6 and 7, III Year; 2 hrs. per week, both terms.

This is a course of lectures in hydraulics devoted to the development and discussion of formulae relating to the flow of water in pipes, the measurement of discharge by various methods, such as orifices and weirs, the conditions of flow obtaining in open channels, artificial and natural, and in pipes flowing partially full, together with other kindred subjects.

The object of this course is to provide the student with a good working knowledge of the fundamental principles of hydraulics, such as are useful in practical work, and are necessary to the intelligent investigation of more advanced problems, such as the design of water supply, sewerage and irrigation systems, and water power plants.

Text book: Hydraulics for Engineers—Angus.

206. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Departments 1, 2, 3 and 7, III Year; one 3 hr. period per week, second term.

Department 6, III Year; average $1\frac{1}{2}$ hrs. per week, second term.

The work in this course is intended to illustrate the lecture course given in hydraulics and to give the student some working acquaintance with the formulae derived. Experiments are made to determine the coefficients for orifices of the various types used in practice and for weirs. The results of these experiments are used in measuring the discharge in subsequent experiments on meters and for the determination of hydraulic resistances in various cases of flow in pipes. The complete course illustrates very fully the application of the course of lectures to actual cases.

207. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 1 lecture per week, both terms.

A course of lectures dealing with the various problems of unsteady flow such as occur in power plants, penstocks, etc. Much of the work is done by the process of arithmetic integration, and the lecture work is supplemented by problems solved by the students in the work rooms, the time for which is included in course 209. Surges, water hammer, stream flow data, etc., are discussed.

The problems of collection of water for power purposes, use of the mass curve, rainfall and evaporation, turbine governing, etc., are also treated as far as possible.

Text book: Hydraulics for Engineers—Angus.

208. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 2 lectures per week, both terms.

The most important question considered and to which most of the lectures are devoted is the theory of turbines and centrifugal pumps, the effect of the design on the speed, discharge and efficiency being fully taken up. The course includes the selection of turbines and pumps for given service; intakes, draft tubes and all matters connected with hydraulic power plants.

Text book: Hydraulics for Engineers—Angus.

209. Hydraulics. R. W. Angus, R. Taylor.

Department 7h, IV Year; 9 hrs. per week, first term, 6 hrs. per week, second term; Department 3, average of $7\frac{1}{2}$ hrs. per week in 3 and 2 hr. periods.

A laboratory course devoted to experimental work on turbines of various types and centrifugal and turbine pumps and other similar devices. This experimental work is arranged to illustrate the lectures on turbine and pump design. The experiments are made on hydraulic models and on two large turbine pumps used in the labor-

atory supply, as well as on apparatus specially designed for instruction. Various methods of measuring water-power and the efficiency of machines are also given. A list of the equipment now available and which is used in this course, is given in Section XII.

210. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Department 8, IV Year; 3 hrs. per week, second term.

A laboratory course of experiments on orifices, weirs, meters, etc. See course 206.

211. Hydraulics. R. W. Angus, R. Taylor.

Department 1a, IV Year; 1 hr. lecture per week, both terms.

Laboratory course of 1 three hr. period per week, first term.

The course of lectures deals with general hydraulic problems such as surges in pipe lines, water hammer, flow in open channels and backwater, mass curves, a general discussion of pumps and turbines.

The laboratory course consists of class room instruction and experiments bearing on the lectures.

Text book: Hydraulics for Engineers—Angus.

212. Hydrostatics. R. W. Angus.

Departments 3, 6 and 7, II Year; 1 hr. per week, second term.

Fluid pressure and its application in the design of engineering structures. Forces acting on the bottoms and ends of tanks; pressures on pipes, gates and walls; stability of dams; laws governing the equilibrium of floating bodies.

213. Properties of Fluids. G. R. Lord.

Department 3, I Year; 1 hr. per week, both terms.

This course of lectures is intended to prepare the student for work in hydraulics, thermodynamics and machine design.

214. Properties of Fluids. G. R. Lord.

Department 3, II Year; 1 hr. per week, both terms.

This lecture course is a continuation of Course 213.

THERMODYNAMICS AND HEAT ENGINES

216. Steam and Heat Engines. E. A. Allcut.

Departments 3 and 7, II Year; 1 lecture per week, both terms.

Departments 2 and 8, II Year; 1 lecture per week, first term.

A course of lectures dealing with the history and development of the steam engine with special reference to the theory and design of valves and valve operating mechanisms. The principles of heat engines and the various forms of heat engine are also discussed briefly.

217. Thermodynamics. E. A. Allcut.

Departments 3, 6 and 7, III Year; 2 lectures per week, both terms.

In this lecture course the laws of heat are used to develop the characteristic equation for a perfect gas and the use of thermal lines on the pressure-volume diagram. The properties of Carnot's cycle are then considered, followed by application of these principles to the hot-air engine, internal combustion engine and air compressor. A consideration of the properties of vapours and their application to the steam engine cycle and refrigeration concludes the course.

218. Heat Engines. R. C. Wiren.

(*a*) Departments 3, 7, 8, and 8a, III Year; 1 lecture per week, both terms.

This course of lectures is intended to supplement the general lecture course in Thermodynamics by showing the practical application of the laws discussed therein. The laws of combustion, their application to the boiler practice and the generation and uses of steam are the principal points considered.

(*b*) Department 3, III Year; 1 lecture per week, both terms.

These lectures are a further development of the internal combustion work commenced in the Second Year, the influence of thermodynamic considerations on the design of heat engines, and problems in heat transfer, being discussed. The laws of heat transmission and their influence on Heating and Ventilation problems are also considered.

219. Thermodynamics and Mechanical Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, III Year; 1 three hr. period per week, both terms.

Department 7, III Year; 3 hrs. per week, first term.

Time to be in three-hr. periods in all cases.

This laboratory course is designed to assist in a clearer understanding of thermodynamics, machine design and mechanics of machinery. The work in thermodynamics consists in the setting of slide valves, indicating engines measuring the brake horse-power, simple engine and boiler tests and the testing of gas and gasoline engines under various conditions. The mechanical laboratory work deals with the efficiency of belts as well as of several machines of simple construction. An examination of lubricating oils is also made by means of well-known methods. Experiments are also made on the balancing of reciprocating and rotating masses.

220. Thermodynamics. E. A. Allcut.

Departments 3 and 7t, IV Year; 2 hrs. per week, both terms.

This is a continuation of course 217, the general thermodynamic theory being studied from the conception of the thermodynamic

surface. The theory of the flow of gases and vapours through orifices, nozzles and pipes is then discussed, and its application to the various forms of turbine is outlined. Thermodynamic losses and their causes, as exemplified by the steam power plant, are studied in detail.

221. Heat Engines. E. A. Allcut.

Departments 3 and 7t, IV Year; 1 hr. per week, both terms.

The first part of the course deals with refrigeration and includes studies on reversed heat engines, as exemplified by air, vapour compression and absorption machines. The various cycles employed and the properties of refrigerating vapours are studied in detail. Applications of refrigeration, as in air conditioning and industrial processes, are also described.

The second part is devoted to internal combustion and begins with a discussion of the constant volume and constant pressure cycles together with their associated losses. The properties of the various liquid fuels and their influence on combustion in a cylinder are also studied. The course concludes with a consideration of high speed compression ignition engines and the problems associated therewith.

222. Thermodynamics. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, IV Year; average $7\frac{1}{2}$ hrs. per week, and 7t, IV Year, 9 hrs. per week, first term, 6 hrs. per week, second term.

The work in this year is a continuation and extension of the work covered in the Third Year laboratory course. Careful tests are made of heaters and of engines of various types, such as simple, tandem and cross-compound steam engines; steam turbine; refrigerating machine; injectors and steam pumps, etc.; and an application is made of Hirn's analysis and the entropy diagram to the results obtained. A complete set of experiments is made on each machine and the result plotted so as to show clearly to the student the effect of various alterations in the adjustment of the engine on the resulting efficiency.

Several modern gas and gasoline engines give ample opportunity for the study of this type of engine, and facilities are provided for sampling the gas supply and exhaust.

Two experimental stacks and three boilers enable results to be obtained on boiler efficiency and chimney draft.

223. Thermodynamics. E. A. Allcut.

Departments 1, 8 and 8a, III Year; 1 lecture per week, both terms.

Department 2, IV Year; 1 lecture per week, both terms.

The general principles of thermodynamics, the properties of a perfect gas and their application to the Carnot cycle are first studied.

This is followed by a consideration of the air compressor cycle, some details of air compressor operation and the theory of the flow of air through pipes and orifices. The properties of vapours and the principles of steam engine operation are also discussed.

224. Thermodynamics Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 1, III Year; eight 3 hr. periods, second term.

Department 6, III Year; average $1\frac{1}{2}$ hours per week, second term.

Departments 8 and 8a, III Year; 3 hrs. per week, second term.

Department 2, IV Year; 3 hrs. per week, first term.

A course of experiments with steam and gas engines, compressed air, etc.

225. Thermodynamics. E. A. Allcut, R. C. Wiren.

Department 5, III Year; 2 hrs. lecture per week, both terms, and 3 hrs. per week in the laboratory, second term.

The lecture course consists of a study of thermodynamic cycles and their application to engines, compressors, turbines and refrigerating machines. The properties and the limitations of the various working fluids are also considered in relation to their use in such machines.

The laboratory work comprises a series of experiments designed to show how the principles given in the lecture courses are applied in practice.

226. Aircraft Engines. E. A. Allcut.

Department 5h, IV Year; 1 hr. per week, both terms.

The lectures in the first term will consist partly of descriptions of the various types of aircraft engines and will include a consideration of the laws of heat transfer and their application to cooling problems in aircraft engine cylinders. Those in the second term will be identical with Course 221 and will be taken in conjunction with IV Year, Departments 3 and 7t.

MACHINERY

227*a*. Shop Work. W. G. McIntosh.

Department 3, III Year; 600 hrs.

The student is required to obtain this practical experience in industry, and preferably in the foundry, the forge shop and the machine shop. Such work assists the student in his understanding of the lecture and laboratory work throughout his entire course in Mechanical Engineering, and particularly the design work in his Third and Fourth Years.

Instruction regarding the type of work which is acceptable, and any special requirements, will be given to the student during his Second Year.

227*b*. Shop work. W. G. McIntosh.

Department 3, IV Year; the balance of 1200 hours.

This is a continuation of the work outlined in the Third Year course 227a.

Instruction regarding the type of work which is acceptable, and any special requirements, will be given to the student during his Third Year.

228. Machines and Processes. W. G. McIntosh.

Department 3, I Year; 1 hr. per week, both terms.

In this lecture course the various machines and processes used in shops are treated in a simple manner, so as to acquaint the student with the nautre of such work. The course is largely descriptive.

Text book: Factory Equipment—Roe and Lytle.

228*a*. Machines and Processes. W. G. McIntosh.

Department 3, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of Course 228 in the First Year, but dealing more particularly with materials of design and production methods. In addition, standards, tolerances, limits, fits and mechanical drafting room practice will be explained.

Text books: Factory Equipment—Roe and Lytle. Machine Drawing—Tozer and Rising. Drawings and Drafting Room Practice.

229. Machinery. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 1, III Year; 1 lecture per week, both terms, and 1 three hour drafting board period per week, second term.

This course of lectures and work on the drafting board is intended to give the civil engineer some acquaintance with the machinery used in bridges, machinery for conveying and moving materials, shovels, pumping, etc. The drafting problems will be used to illustrate the lecture course.

230. Theory of Mechanism. R. Taylor.

Departments 3 and 7, II Year; lectures 2 hrs. per week and problems $1\frac{1}{2}$ hrs. per week, both terms.

This course of lectures treats of the elementary construction of machines and of the motions of the various parts. Methods of determining linear and angular velocities, methods for the solution of elementary problems involving forces and methods for the determination of the mechanical efficiency of machines are discussed. Velocity diagrams, crank effort and torque diagrams are plotted. Cams, toothed gearing and various types and applications of trains of gearing are considered.

Text book: Theory of Machines—Angus.

231. Mechanics of Machinery. W. G. McIntosh.

Departments 3 and 7, III Year; 1 hr. per week, both terms.

This course is devoted to a consideration of accelerations in machines, acceleration and inertia forces and effects, balancing of machines, kinetic energy of machines, speed fluctuations, proper weight of fly-wheel.

Applications of the methods described are made to various machines, including engines, machine tools, link motions, etc., and the lecture work is followed up by the solution of numerous examples in the drafting room.

The methods of analysis employed are those developed in course 230.

Text book: Theory of Machines—Angus.

232. Elementary Machine Design. W. G. McIntosh.

Departments 6 and 7, II Year; 1 hr. per week, both terms.

This is a preparatory course intended to familiarize the student with the different shop methods and processes, casting, forging, machining, etc., used in the production of machine parts, to enable him to make proper provision in the design of such parts to facilitate their production.

In addition, the various standards, machine and pipe threads, tapers, pipe fittings, etc., are described and mechanical drafting room practice explained. Tolerances, limits, fits and gauges are discussed.

Text book: Machine Drawing—Tozer and Rising. Drawings and Drafting Room Practice.

233. Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Departments 3 and 7, III Year; 2 lectures per week, both terms.

The design work averages 8 hrs. per week for Department 3, and 4 hrs. per week for Department 7, the periods to be of not less than 2 hrs. duration.

The lectures in this course deal with the design of various machine elements, including screw threads for fastening and power transmission, shafting, bearings (journal, thrust, ball and roller), belts, pulleys, spur gears, fly-wheels, keys, clutches, springs, etc.

The problems worked out in the drafting room are planned to include the design of all of the above and with a view to developing the student's judgment and sense of proportion in design.

Text book: Design of Machine Elements—Faires.

234. Machine Design—W. G. McIntosh, G. H. Hally, T. C. Graham.

Departments 2, 6, 8 and 8*a*, IV Year; 1 lecture per week, both terms.

The design work occupies 3 hrs. per week for the second term only.

The lectures in this course deal with the design of various machine elements, particularly those likely to be met with in chemical and metallurgical plants, and in mining work.

The problems worked out in the drafting room are designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical and metallurgical apparatus, and mine machinery.

234*a*. Elementary Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 5, II Year; 1 lecture per week, both terms, and one three hour drafting board period per week, both terms.

This course of lectures and work on the drafting board is intended to give some acquaintance with the selection of materials and their use in the design and construction of machinery. Machine parts are analysed as to suitable materials, production methods, the nature and magnitude of the stresses encountered, the standard practice in detailing such parts.

Text book: Machine Design—Berard and Waters.

235. Advanced Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 3, IV Year; 2 lectures per week, both terms.

The design work averages 7 hrs. per week, the periods to be of not less than 2 hrs. duration.

The lectures of this course deal with the design of machine frames, hooks, hoisting equipment, crank shafts, gears of various kinds (herring-bone, bevel, screw) worm gearing, clutches and brakes.

The work in the drafting room is devoted to the design of complete machines with the object of giving the student practice not only in the design of various details, but also in working the various elements into a machine of smooth and harmonious design. The machines chosen as examples for design involve as many new machine elements as possible in order to broaden the training of the student.

Text book: Design of Machine Elements—Faires.

MATHEMATICS

See Advanced Mathematics, p. 114.

236. Calculus. S. Beatty, D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell.

Departments 1, 2, 3, 4, 6, 7, and 8, I Year; 2 hrs. per week, both terms.

Derivation of the fundamental formulae of the differential and integral calculus, with early applications to simple problems concerning graphs, areas, volumes, lengths, centres of gravity, and moments of inertia.

237. Calculus. S. Beatty, D. A. F. Robinson, Miss M. E. G. Waddell. C. E. Miller.

Departments 1, 3, 6 and 7, II Year; 2 hrs. per week, both terms.

Continuation of course 236. The elementary theory reviewed and extended. Special attention to applications with problems in engineering mostly in view. Introduction to the study of simple differential equations.

238. Analytical Geometry. S. Beatty, D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell.

Departments 1, 2, 3, 4, 6, 7 and 8, I Year; 1 hr. per week, first term, 2 hrs. per week, second term.

The course in Elementary Analytical Geometry covers the more familiar propositions in connection with the straight line, circle, parabola, ellipse and hyperbola. The subject is treated so as to illustrate the general methods of analytical geometry.

239. Spherical Trigonometry. J. W. Melson.

Department 1, II Year; 1 hr. per week, first term.

A course of lectures includes the derivation of formulae and their application to the solution of triangles and to practical problems.

Text book: Spherical Trigonometry—Todhunter and Leatham.

240. Method of Least Squares. J. W. Melson.

Department 1, II Year; 1 hr. per week, second term.

The course of lectures includes: The general principles of probability, the law of error, direct measurements of equal and different weights; mean square and probable errors; indirect measurements; conditioned observations; applications to empirical constants and formulae, etc.

Text book: Least Squares—Merriman.

METALLURGY

241. Elementary Metallurgy. G. A. Guess.

Departments 2, 3, 6 and 8, II Year; 1 hr. per week, second term

A course of about 12 lecturcs on furnace metallurgy and present practice, with special reference to iron and steel.

242. Fuels and Combustion. G. A. Guess.

Department 8, II Year; 1 hr. per week, both terms.

A lecture course dealing with fuels, their use, preparation, caloric value and combustion.

243. Metallurgy. G. A. Guess.

Departments 2 and 6, III Year; 1 hr. per week, both terms.

Fuels, temperature of combustion, specific heat, conductivity and problems thereon; chimneys, furnaces, refractories, outline of furnace metallurgy and hydro-metallurgy.

244. Physical Metallurgy. J. A. Newcombe.
Departments 3, 5c, 5s, 5g, 5h, 5e, 6 and 7, III Year; 2 hrs. per week, second term.
A lecture course on general Physical Metallurgy.

245. Metallurgy. G. A. Guess, J. E. Toomer.
Department 8, III Year; 2 hrs. per week, first term; 1 hr. per week, second term.
A lecture course on General Metallurgy accompanied by 3 hrs. laboratory per week, first term, and 6 continuous hrs. per week, second term.

246. Physical Metallurgy. J. A. Newcombe.
Department 8, III Year; 1 hr. per week, both terms.
Changes of phase and of state, pyrometry, preparation of alloys, miscibility of metals, binary, ternary and complex alloys, the use of the microscope, with 3 hrs. laboratory per week, first term.

247. Metallurgy. G. A. Guess, J. E. Toomer.
Departments 2 and 6m, IV Year; 1 hr. lecture per week, both terms; 6 continuous hrs. laboratory per week, second term.
General metallurgy and metallurgical problems.

248. Metallurgy Problems. G. A. Guess, J. E. Toomer.
Department 8, IV Year; 2 hrs. lecture and 4 hrs. laboratory per week, both terms.
Metallurgical book-keeping, balance sheets, thermal balance sheets, methods and processes.

249. Metallurgy. G. A. Guess.
Department 8, IV Year; 1 hr. per week, both terms.
Critical reading and discussion of papers and articles, describing metallurgical processes or dealing with plant arrangement and construction. Metallurgical flow sheets of typical plants.

250. Physical Metallurgy. J. A. Newcombe.
Departments 6m and 8, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

251. Physical Metallurgy. J. A. Newcombe.
Department 2, IV Year; 2 hrs. lecture and 3 hrs. laboratory per week, first term.
The physical properties and structure of iron and steel and the more common alloys.

252. Physical Metallurgy. J. A. Newcombe.
Department 1, II Year; 1 hr. lecture per week, second term.
The physical properties of metals and alloys used in civil engineering practice.

253. Heat Treatment of Iron and Steel. J. A. Newcombe.
Department 3, IV Year; 1 lecture per week, both terms.
Heat treatment of iron and steel, case carburizing, case hardening and malleableizing.

CERAMICS

254*a*. Ceramics. R. J. Montgomery.
Department 8a, III Year; 4 hrs. per week, first term; 2 hrs. per week, second term.
Lectures covering origin, properties and classification of clays and other ceramic materials from a manufacturing standpoint; methods of manufacture, including preparing, shaping and burning clay ware.

254*b*. Ceramics. R. J. Montgomery.
Department 8a, III Year; 2 hrs. per week, second term.
Lectures on the composition of clear and coloured glazes.

254*c*. Ceramics. J. E. Toomer.
Department 8a, III Year; 1 hr. per week, second term.
Lectures and problems on calculations necessary for the compounding of ceramic bodies and glazes.

254*d*. Ceramics. R. J. Montgomery.
Department 8a, III Year; 9 hrs. per week, first term; 3 hrs. per week, second term.
Work on the identification and testing of clays.

254*e*. Ceramics. J. E. Toomer.
Department 8a, III Year; 6 hrs. per week, both terms.
Laboratory practice in the analysis of ceramic materials.

254*f*. Ceramics. R. J. Montgomery.
Department 8a, IV Year; 2 hrs. per week, first term.
Lectures on composition and properties of refractory material; composition of bodies made with ceramic material, with special reference to white-ware and porcelain.

254*g*. Ceramics. R. J. Montgomery.
Department 8a, IV Year; 2 hrs. per week, second term.
Lectures on the manufacture and composition of glass; manufacture and composition of iron enamels.

254*h*. Ceramics. R. J. Montgomery.
Department 8a, IV Year; 1 hr. per week, second term.
Lectures on specifications, testing and methods of testing ceramic materials.

254*i*. Ceramic Laboratory. R. J. Montgomery.
Department 8a, IV Year; 7 hrs. per week, first term; 9 hrs. per week, second term.
Advanced work on compounding and testing ceramic bodies and glazes.

MINERALOGY

255. Elementary Mineralogy. J. E. Thomson.

Departments 2, 5 and 8, I Year; 2 hrs. per week, first term.

After introducing the student to the chief chemical, physical, and crystallographic characteristics of minerals, the course becomes descriptive and deals with about one hundred of the minerals most important from the industrial or scientific point of view.

Text book: Text-book of Mineralogy—Dana.

256. Mineralogy. J. E. Thomson.

Department 6, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

Introduction to determination of minerals by inspection and physical tests.

Text book: Mineral Tables—Eakle.

257. Primary Mineralogy. A. L. Parsons.

Department 1, II Year; 2 hrs. per week, first term.

A very brief introduction to the study of minerals and rocks.

Text books: Minerals and How to Study Them—Dana. Handbook of Rocks—Kemp.

258. Mineralogy. J. E. Thomson.

Department 2, I Year; 1 hr. per week, first term; 3 hrs. per week, second term.

Determination of minerals by inspection and by means of physical tests; introduction to blow-pipe practice.

Text books: Mineral Tables—Eakle. Determinative Mineralogy—Lewis.

258*a*. Mineralogy. J. E. Thomson.

Departments 5 and 8, I Year; 1 hr. per week, first term.

Determination of minerals by inspection and by means of physical tests.

Text book: Mineral Tables—Eakle.

259. Mineralogy. A. L. Parsons, J. E. Thomson.

Department 1, II Year; 1 hr. per week, first term; 2 hrs. per week, second term.

Determination of minerals by inspection and by means of physical tests; study of common rock types and their identification.

Text books: Mineral Tables—Eakle. Handbook of Rocks—Kemp.

260. Elementary Petrography. T. L. Walker.

Department 2, II Year, and Departments 5g and 8a, III Year; 1 hr. per week, both terms.

A course of lectures and laboratory work introducing the student to the microscopic study of rocks.

Text book: Handbook of Rocks—Kemp.

261. Mineralogy. J. E. Thomson.

Department 2, II Year; 2 hrs. per week, both terms.

Determination of minerals by means of the blow-pipe and physical properties.

Text books: Mineral Tables—Eakle. Determinative Mineralogy —Lewis.

262. General Petrography. A. L. Parsons.

Departments 2, III Year, and Department 5g and 8a, IV Year; 1 hr. per week, both terms.

Study of the chief rock-forming minerals and of some phases of petrography not covered in the course of the previous year.

Text books: Minerals in Rock-Sections—Luquer. Petrology for Students—Harker.

263. Petrography. T. L. Walker.

Department 2, III Year, and Departments 5g and 8a, IV Year; 2 hrs. per week, both terms.

Study of the chief rock-forming minerals, of rocks in thin sections and in hand specimens.

Text books: Petrology for Students—Harker. Minerals in Rock Sections—Luquer.

264. Mineralogy. T. L. Walker.

Department 5s, III Year; 1 hr. lecture per week, both terms.

A lecture course on morphological crystallography.

Reference book: Crystallography—Walker.

MODERN LANGUAGES

265. German. H. Boeschenstein.

Department 6, I Year, 2 hrs. per week, both terms; II, III and IV Years, 1 hr. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

265*a*. German. C. Barnes.

Department 5, I Year; 2 hrs. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: First German Course for Science Students—Fiedler and Sandbach.

265*b*. German. C. Barnes.

Department 5, II Year; 1 hr. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: Second German Course for Science Students—Fiedler and Sandbach.

266. Spanish.

Department 6m, IV Year; 1 hr. per week, both terms.

An introduction to Spanish grammar, pronunication and practice in reading Engineering Spanish.

MUNICIPAL ENGINEERING

267. Sanitary Engineering. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. lecture per week, both terms.

267a. Sanitary Engineering. A. E. Berry, W. J. Smither.

Department $1a_1$, IV Year; 3 hrs. laboratory per week, second term.

Consideration is given to the problems of water supply, sewerage and municipal sanitation as viewed by the engineer. The lectures and laboratory work include the design of water distribution and sewer systems, as well as water and sewage treatment works. Problems are assigned from assumed data and from material secured in the field. Excursions to places of interest are also arranged from time to time.

Reference books: Public Water Supplies—Turneaure and Russell. Manual of Water Works Practice of the American Water Works Association. American Sewerage Practice—Metcalf and Eddy, 3 vols. Solving Sewage Problems—Fuller and McClintock.

268. Highway Engineering. W. L. Sagar.

Department $1a_1$, IV Year; 1 hr. lecture per week, second term, and 3 hrs. laboratory per week, second term.

This course of instruction deals with the design, construction and maintenance of highways and street pavements, and with the properties of the materials employed. The laboratory course deals with subsoils, bituminous and non-bituminous materials of construction.

Text books: Construction of Roads and Pavements—Agg. Rural Highway Pavements—Harger.

RAILWAY ENGINEERING

269. Railway Engineering. W. M. Treadgold.

Department $1a_2$, IV Year; 1 hr. per week, first term, 2 hrs. per week, second term, and 4 hrs. per week, second term, in the drafting room.

This course of lectures and practical work is intended to make the student acquainted with the general principles of railway engineering and transportation. The economic theory of location, train resistance, effect of grade distance and curvature rise and fall, maintenance of way, yards and terminals, tunnels and street railway practice; also the principles of urban and interurban transportation.

Text books and references: The Economic Theory of Railway Location—A. M. Wellington. Proceedings of the Railway Engineering Association.

269*a*. Railway Structures. C. R. Young.

Department $1a_2$, IV Year; 1 hr. lecture per week, first term; 2 hrs. laboratory per week, second term.

A course of lectures with exercises covering alternative bridge layouts with comparative estimates of costs, temporary and permanent trestles, tunnels, tunnels vs. bridges, buildings, turn-tables, snow-sheds and shelters.

SURVEYING

270. Surveying. S. R. Crerar.

Departments 1, 2, 3, 7 and 8, I Year; 1 hr. per week, both terms.

The lecture course includes the general principles; surveying with the chain, the compass and chain and the transit and chain, and level, the applications of trigonometry to inaccessible heights and distances; mensuration of surfaces, co-ordinate surveying, division of land, etc.

Text books: Plane Surveying—Tracy. Theory and Practice of Surveying—Johnson and Smith. Elementary Surveying—Breed and Hosmer.

270*a*. Surveying. T. L. Rowe.

Department 4, I Year; 1 hr. per week, first term.

The lecture course includes the general principles and practice of surveying with the chain, the transit, and the level, with special consideration given to the survey of lots and small estates.

271. Field Work. S. R. Crerar, J. W. Melson, T. L. Rowe.

Departments 1, 2, 3, 7 and 8, I Year; 6 hrs. per week, first term.

This course comprises testing chains; practice in chaining; a complete survey of a piece of land with the chain and transit; keeping of field notes; the use of the transit and compass in surveying closed figures and traverse lines and in ranging straight lines; plotting by latitudes and departures, and otherwise computing areas. Instrumental work with level, including roadway improvement.

271*a*. Field Work. T. L. Rowe.

Department 4, I Year; 3 hrs. per week, first term.

This course comprises practice in chaining, a complete chain survey of a small estate, keeping field notes, the use of the transit and level and their application in building layouts, cross section work with the level, including calculation for excavations.

272. Surveying. W. M. Treadgold.

Department 1, II Year; 1 hr. per week, both terms.

This course of lectures takes up in detail, simple, reverse and compound curves as applied to railroad and highway surveying. It also includes stadia, plane table and photographic surveying as applied to topographic work, and the main features of mine and hydrographic and aerial surveying.

Text books: Henck, Searles, Allen (Field books for Engineers) Theory and Practice of Surveying—Johnson and Smith. Surveying —Breed and Hosmer.

272*a*. Surveying. E. W. Banting.

Department 2, II Year; 1 hr. per week, both terms.

This course of lectures takes up mine surveying with problems related thereto. It also includes the simple curve as applied to railroad surveying, stadia topographical surveying, plane table and the main features of hydrographic surveying.

Text books: Surveying—Breed and Hosmer. Mine Surveying Durham.

273. Field Work. W. M. Treadgold, E. W. Banting.

Department 1, II Year; 9 hrs. per week, first term.

Department 2, II Year; 6 hrs. per week, first term.

This course of instruction embraces all adjustments of the transit and level, minor problems in triangulation and traversing, levelling and plane table practice, curves and topography.

274. Surveying. W. M. Treadgold.

Department 1, III Year; 1 hr. per week, both terms.

This course of lectures takes up the work of the railroad engineer on construction, including profiles, cross-sectioning, computation of volume of earthwork, overhaul, transition curves, laying out turnouts, frogs and switches, etc. Also a discussion of trigonometric and barometric levelling.

Text books: Field Engineering—Searles. Railroad Curves and Earthworks—Allen.

Photographic Surveying, see 189, 189a.

275. Survey Camp. W. M. Treadgold, S. R. Crerar, E. W. Banting, J. W. Melson.

Departments 1 and 2, III Year; Department 1b, IV Year.

The University of Toronto Survey Camp is ideally located in County of Haliburton at an elevation of 1,000 feet above sea level and comprises a tract of field, woodland and lake front property. The country is broken and rolling and with the numerous small lakes and streams in the immediate vicinity is admirably suited for work and the various problems that arise in practical surveying. Since the camp has been established, Professor Stewart has made a careful triangulation survey, establishing triangulation stations near the camp connected with primary stations of the Geodetic Survey of Canada. This triangulation has been adjusted and complete computations made. Also through the interest and co-operation of Mr. Noel Ogilvie, Director of the Geodetic Survey, permanent bench marks were established at Miner's Bay on Gull Lake, connecting up levels with the precise level net of Canada.

By rail the camp may be reached by taking the Canadian National train leaving Lindsay for Haliburton, getting off at Gelert, where conveyances are always on hand to drive to the camp, a distance of 12 miles, by way of Minden, the county town.

All mail, telegrams, or telephone messages should be addressed to the "University Survey Camp, Minden, Ontario". Baggage should be checked to Minden via Gelert on the Canadian National Railway.

Each student will provide at least three pairs of heavy blankets, sheets, towels, raincoats, personal supplies, all of which should be limited to about 60 lbs., and carried in suit cases or dunnage bags.

This course includes:

(*a*) Secondary Triangulation and Base Line Measurements.
(*b*) Stadia, Plane Table and Boundary Traverses.
(*c*) Highway and Railway Location.
(*d*) Cross Sectioning and Computation of Earthwork.
(*e*) Stream Gauging and Discharge Measurements.
(*f*) Hydrographic Surveying.
(*g*) Photographic and Micrometer Work.
(*h*) Stadia and Plane Table Topography.
(*i*) Mine Surveying.
(*j*) Observations for Time, Azimuth and Latitude.
(*k*) Geological Survey.

A complete field course in Practical Astronomy and Geodesy is given to students taking this option in the Fourth Year, Department of Civil Engineering including the adjustment of a triangulation, observations for time, latitude and azimuth and base line measurements.

Students in Departments 1 and 2 will be required to take the Survey Camp between the Second and Third Year; and, on failure to do so, this subject will be carried as a supplemental in the Third Year.

PRACTICAL EXPERIENCE

276. Practical Experience.

Department 7.

Each student registered in the Department of Electrical Engineering is required to submit to the Secretary of the Faculty, not later than January 15th in each session, certificates and a detailed report regarding practical experience. Certificate forms, the nature of the report, and information regarding the kinds of experience to be sought, are available at the office of the Secretary.

PHYSICAL TRAINING

280. Physical Training. G. D. Porter.

Required in all Departments, I and II Years, and optional in the III and IV Years.

By order of the Board of Governors, each male undergraduate proceeding to a degree must take Physical Training in the first and second academic years of his course. In each session in which Physical Training is compulsory he must first undergo a medical

examination by the Director of the University Health Service, and must then register for Physical Training at the office of the Athletic Association in Hart House. Students of all years who wish to take part in any form of athletics or physical exercise, must first undergo a medical examination by the Director. Those classified as A1 may elect to take any form of competitive athletics during the season in which that form of sport is in progress.

Military training in the C.O.T.C. constitutes an option in Physical Training (see page 159).

ZYMOLOGY

283. Zymology.

Department 6z, IV Year.

A study of the phenomena of fermentation and of the mechanism of enzyme action.

THESIS

285. Thesis.

Required in all Departments, IV Year, with the exception of Department 4, Architectural Design Option and Departments 5g and 5i. Department 3, IV Year; 1 hr. per week, both terms. For requirements in Department 2, see course 67, and in Department 6, see course 113.

Each student must prepare a thesis on a subject and in a form approved by the head of the department in which the student is registered.

ADVANCED MATHEMATICS

See Mathematics, p. 104

Elective courses in Mathematics are offered to students of the I and II Years. Students of the I Year will be informed at the beginning of the fall term whether or not they are qualified to proceed with the advanced course. Those who take this course will try the ordinary pass examination papers, plus an advanced problem paper at the end of the year. The pass standing for proceeding to the Second Year will be determined by the ordinary paper, the marks of the problem paper being used to determine whether or not the student has shown sufficient proficiency to take the advanced work of the Second Year.

Students of the Second Year taking the advanced course will try the ordinary pass examination papers plus an advanced problem paper, pass standing being determined by the ordinary papers and proficiency for further advanced work by the problem paper.

Although these courses are entirely elective, students who are qualified to take them are urged to proceed with this work.

The names of those who pass these advanced papers will be published with the regular results each year as having completed these courses.

290. Advanced Mathematics. The Staff in Mathematics.

All Departments, I year; 3 hrs. lecture per week, first term; 4 hrs. lecture per week, second term.

In addition to the regular material included under courses 236, 238, students will take work on advanced problems on conics; parametric equations on conics; curve tracing and asymptotes; circular and hyperbolic functions; expansions of functions of one variable; partial fractions; elementary theory of equations; determinants up to the third order; one-parameter families of curves and their differential equations; differential equations in elementary mechanics; curve fitting and approximate integration.

291. Advanced Mathematics. The Staff in Mathematics.

Departments 1, 3, 6, and 7, II Year; 2 hrs. lectures per week, both terms.

In addition to the regular material included under course 237, students will take work on elementary space geometry; partial differentiation; expansions of functions of more than one variable; multiple integration; ordinary differential equations of first order and first degree; linear differential equations with constant coefficients; applications to problems in mechanics.

292. Algebra and Calculus. S. Beatty.

Department 5, I Year; $3\frac{1}{2}$ hrs. per week, both terms.

Polynomials and rational functions, elementary theory of equations, inequalities, determinants, limits, summation of series, binomial, exponential, and logarithmic series, expansions of the circular and hyperbolic functions and their inverses, the methods and operations of the Calculus considered intuitively and illustrated by applications, and elementary differential equations.

Text book: Introduction to the Calculus—Osgood.

293. Analytical Geometry of the Plane. S. Beatty.

Department 5, I Year; $1\frac{1}{2}$ hrs. per week, both terms.

Cartesian and polar coordinates, transformation of coordinates, straight lines and curves of the second degree, projective properties of conics, the principle of duality, higher plane curves.

Text book: Analytical Geometry—Nowlan.

294. Differential Calculus. J. D. Burk.

Department 5, II Year; 3 hrs. per week, both terms.

Differentiation, Taylor's theorem and series for functions of one or more variables, families of curves and surfaces and their differential equations, Jacobians, geometrical and mechanical applications.

Text books: Introduction to the Calculus—Osgood. Differential and Integral Calculus, Vol. I—Courant.

295. Integral Calculus and Differential Equations. I. R. Pounder.
Department 5, II Year; 3 hrs. per week, both terms.
The indefinite integral, integration of rational and other special functions, the definite integral, differentiation with respect to a parameter, multiple integration, Fourier's series, geometrical and mechanical applications, approximate integration, introduction to ordinary differential equations.
Text books: Introduction to the Calculus—Osgood. Differential and Integral Calculus, Vol. 1—Courant.

296. Analytical Geometry of Space. S. Beatty.
Department 5, II Year; 1 hr. per week, both terms.
Cartesian and other systems of point coordinates, curves and surfaces and their equations in parametric or non-parametric form, data fixing planes, lines, conics, and quadrics, generating lines and circular spectrons of quadrics, classification of quadrics, tangent cones to quadrics, metric and projective properties of quadrics, families of quadrics, ruled surfaces and surfaces of revolution.
Text book: Analytic Geometry—Nowlan.

297. Differential Equations. I. R. Pounder.
Department 5, III Year; 1 hr. per week, both terms.
First order equations solvable by quadratures, depression of the order, the linear equation, systems of linear equations with constant coefficients, first order partial equations in two variables, total differential equations, particular equations of the second order.
Text books: Differential Equations—Piaggio. Differential Equations—Cohen.

298. Introduction to the Theory of Functions. S. Beatty.
Department 5, III Year; 1 hr. per week, both terms.
Green's and Stokes's Theorems, conformal mapping of one plane region on another, the complex variable, analytical functions, Cauchy's Theorem and Integral Formula, Poisson's Formula, Taylor's and Laurent's series, analytic continuation and the Schwarz reflection principle, singularities and their significance.
Text book: Theory of Functions—Rothe, Ollendorff, and Pohlhausen.

PHYSICS

301. Properties of Matter, Mechanics, and Heat. John Satterly.
Department 5, I Year; 3 hr. lecture per week and 4½ hrs. laboratory per week, both terms.
This course involves lectures and laboratory work supplementing the work taken in the lectures. In addition to the work in the divisions indicated in the title, the course also includes lectures and problems on calculations for science students involving the use of the elementary calculus and statistics. The course is planned in

conjunction with the work taken under the title of Engineering Mechanics.

Reference books: Dynamics—Duncan and Sterling. Heat—Gray. Analytical Mechanics—Barton. Mechanics of Fluids—Barton. Properties of Matter—Wagstaff. Heat—Stewart and Satterly. Heat—Draper. Mathematical and Physical Tables—Clark. Calculus made easy—Thompson. Theory of Measurements—Tuttle and Satterly.

302. Elementary Magnetism and Electricity. L. Gilchrist.

Department 5, II Year; 1 hr. lecture per week, first term; 2 hrs. lecture per week, second term.

This course deals with the fundamental theory of magnetism and electricity, including the introduction of electron theory and alternating currents.

Reference books: Advanced Text-book of Magnetism and Electricity—Hutchinson. A treatise on Electricity—Pidduck. Electricity and Magnetism—Starling. Mathematical Physics, Vol. 1—Barlow.

303. Elementary Light. H. A. McTaggart.

Department 5, II Year; 1 hr. lecture per week, both terms.

This course deals with the fundamental theory of light, including treatment of interference, diffraction, polarized light, and the introduction of geometrical optics.

Reference books: Light for Students—Edser. Introduction to Physical Optics—Robertson. Optical Measuring Instruments—Martin.

304. Acoustics. E. F. Burton.

Department 5, II Year; 1 hr. lecture per week, first term.

This course deals with the fundamental theory of acoustics, including stationary waves and elementary treatment of architectural acoustics and sound transmission.

Reference books: Science of Musical Sounds—D. C. Miller. Speech and Hearing—Fletcher. Sound—A. B. Wood. Acoustical Engineering—West. Sound—F. R. Watson.

305. Magnetism and Electricity, Light, and Acoustics.

Department 5, II Year; 3 hrs. laboratory per week in the first term, and 6 hrs. laboratory per week in the second term.

This laboratory work is carried out under the direction of the staff in Physics and covers lectures dealt with in courses 302, 303 and 304.

306. Mathematical Operations Applied to Physics. C. Barnes.

Department 5, III Year; 1 hr. lecture per week throughout the year.

This course involves an account of vectors illustrated by the

application of vector algebra to physical problems, and an elementary treatment of such things as Fourier Series and Spherical Harmonics.

307. Theory of Potential and Electrical Measurements. E. F. Burton.

Departments 5c, 5s, 5g and 5i, III Year; 1 hr. lecture per week throughout the year.

This course deals with the elementary theory of potential as applied particularly to electricity and magnetism.

Reference books: Electricity and Magnetism—Starling. Principles of Electricity—Page and Adams.

308. Electron Tubes and High Frequency Circuits. D. S. Ainslie, A. Pitt.

Departments 5s and 5g, III Year; 1 hr. lecture per week throughout year.

This course involves the fundamental theory of electron tubes together with the treatment of the various measurements involved in work with high frequency circuits.

Reference books: Electron Tubes—Williams. Principles of Radio Communication—Morecroft. Wireless Principles—Palmer.

309. Properties of Matter. John Satterly.

Department 5, III Year; 2 hrs. lecture per week throughout the year.

This course involves advanced work on properties of matter, dealing very intensively with gravitation, elasticity, viscosity, surface tension and kinetic theory of gases.

Reference books: Properties of Matter—Poynting and Thomson. General Properties of Matter—Newman and Searle. Applied Mathematics—Perry. Experimental Physics—Searle. Practical Physics—Watson. The Mechanical Properties of Fluids—Drysdale and others.

310. Heat. John Satterly.

Departments 5c, 5s, 5g, 5h and 5i, III Year; 1 hr. per week, both terms.

A study of thermometry and pyrometry, the absolute scale of temperature, the mechanical equivalent of heat, the kinetic theory of gases, equations of state, low temperature work, specific heats, vaporization, fusion, expansion, transfer of heat by conduction and convection; radiation and radiation pyrometry, the second law of thermodynamics and its simple applications.

Reference books: Heat and Thermodynamics—Roberts. Methods of Measuring Temperature—E. Griffiths.

311. Physical Laboratory.

Department 5, III Year; 6 hrs. laboratory per week for the first term, and 3 hrs. laboratory per week for the second term.

This laboratory work includes experiments illustrating the principles involved in the four preceding courses.

312. Optics. H. A. McTaggart, K. B. Jackson.

Departments 5c, 5s, 5g, 5e and 5i, III Year; 1 hr. lecture and 3 hrs. laboratory per week throughout the year.

Department 5h, III Year; 1 hr. lecture and 3 hrs. laboratory per week, second term.

This course deals with geometrical and physical optics and photometry as applied to optical instruments and with photography as a scientific implement.

Reference books: Optical Measuring Instruments—Martin. Photometry—Walsh.

313. Hydrodynamics. H. A. McTaggart.

Department 5h, III Year; 1 hr. per week, both terms.

A lecture course for beginners on the hydrodynamics of a perfect fluid with applications to motion in liquids and gases. Reference will be made to some of the simpler cases of viscous flow. The course will be illustrated by experiments.

Text books: Treatise on Hydromechanics—Ramsay. Aerofoil and Airscrew Theory—Glauert. The Physics of Solids and Fluids—Ewald, Poschl and Prandtl. Hydro and Aeromechanics—Prandtl-Tietjens.

314. Advanced Mathematical Operations used in Physics. C. Barnes.

Departments 5c, 5s, 5h, 5e and 5i, IV Year; 1 hr. per week, both terms.

This is a continuation of course 306 to include further properties of vector fields, Cartesian tensors, boundary value problems in potential theory, simple problems in calculus of variations, and certain partial differential equations.

315. Conduction through Gases, Radioactivity and Atomic Structure. John Satterly.

Departments 5c and 5s, IV Year; 1 hr. per week, both terms.

Kinetic theory of gases, electrical discharge through gases, the electron, elementary X-rays and crystal structure, ionization, the development of radioactivity and its use in the physical and geological sciences.

Text: Ions, Corpuscles and Ionizing Radiations—Crowther.

Reference books: The Atom—Andrade. Radioactivity—Chadwick. Radioactivity—Rutherford. Heat—Poynting and Thomas.

316. Advanced Acoustics. D. S. Ainslie.

Departments 5c, 5s and 5i, IV Year; 1 hr. per week, first term.

This course deals with the properties and transmissions of acoustical waves. It will bring out the analogies in alternating current theory and other fields in physics. Sound resonance and sound filters.

Texts: Acoustics—Stewart and Lindsay. Applied Acoustics Olson and Massa. Acoustical Engineering—West.

317. Physical Laboratory. H. J. C. Ireton.

Department 5c, IV Year; 3 hrs. per week, both terms.

Department 5s, IV Year; 9 hrs. per week, both terms.

This laboratory course is designed to accompany the lecture courses 315, 316, 318, 319 and 321.

318. Advanced Optics. H. A. McTaggart, H. J. C. Ireton.

Department 5s, IV Year; 1 hr. per week, both terms.

A lecture course on the aberrations in optical instruments and on the interference, diffraction and polarisation of light with practical applications.

Texts: Applied Optics—Martin. Course d'Optique—Bruhat. The Diffraction of Light, X-Rays, etc.—Meyer. Applied Optics and Optical Design—Conrady.

319. Series Spectra. H. J. C. Ireton.

Department 5s, IV Year; 1 hr. per week, second term.

A lecture course outlining the early developments in atomic spectroscopy, the origin of spectral lines, and their empirical classification into series. The application of the derived formulae to hydrogen, helium and the alkali metals is given.

Reference books: Introduction to Modern Physics—Richtmeyer. Introduction to Atomic Spectra—White.

320. Elementary Quantum Theory. Miss E. J. Allin.

Department 5s, IV Year; 1 hr. per week, second term.

The fundamental principles of the quantum theory developed from a historical and experimental standpoint, radiation formulae, photoelectric effect, Compton effect, specific heats.

Reference book: Théorie des Quanta—Bloch.

321. X-Rays and Crystal Structure. H. J. C. Ireton, J. O. Wilhelm.

Department 5s, IV Year; 1 hr. per week, both terms.

The fundamental physical principles of X-rays, their production, properties and applications to the study of crystalline structure. The practical significance of the results obtained is outlined.

Reference books: The Crystalline State—Bragg and Bragg. Applied X-rays—Clark.

322. Geophysics. L. Gilchrist.

Department 5g, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, both terms.

The course involves a study of the physical principles underlying the methods of investigating surface geological structure and the location of mineral deposits. Particular attention is given to magnetic, electrical, electromagnetic, gravitational, seismological, thermometric and radioactive methods of investigation. In the laboratory, experiments which are illustrative of the methods are carried out and typical problems are investigated.

Reference books: A Manual of Seismology—Davison. Modern Seismology—Walker. Lehrbuch der Geophysik—Gutemberg. Elements of Geophysics—Ambronn. Applied Geophysics—Eve and Keys. Geophysical Prospecting, 1929—A.I.M.E. Geophysical Prospecting, 1932—A.I.M.E. Publications of Geological Survey, Department of Mines, Ottawa, Memoirs 165, 170.

323. Wave Motion in Elastic Media. L. Gilchrist.

Departments 5g and 5e, IV Year; 1 hr. per week, both terms.

The course involves the development of the differential equations for the propagation of various types of disturbance through different media. A study is made of the solution of these equations having regard to the initial and final conditions and the boundary conditions of the media associated with the propagation of the disturbance. Typical problems are considered such as (*a*) the propagation of vibrations in strings, rods, membranes and plates, (*b*) the propagation of heat and electricity in planes, cylinders and spheres.

Reference books: Fourier's Series and Spherical Harmonics—Byerly Spherical Harmonics—MacRobert.

324. Physics of Light Production—H. J. C. Ireton.

Department 5i, IV Year; 1 hr. per week, both terms.

A course of lectures dealing with black body radiation, spectral energy distribution and the principles involved in the production of light in various types of sources, filament, flame, and gaseous and vapour tubes.

325. Physical Laboratory. H. J. C. Ireton.

Department 5i, IV Year; 3 hrs. per week, both terms.

A laboratory course to accompany Course 324.

326. Dynamic Meteorology. B. Haurwitz.

Department 5h, IV Year; 1 hr. per week, both terms.

A lecture course intended as an introduction to meteorology applicable to aeronautics. It will deal in elementary form with the statics, dynamics and thermodynamics of the atmosphere. Particular emphasis will be laid on the points which are most important for airplane flight, such as atmospheric turbulence, atmospheric conditions producing an ice coat on airplanes and the interpretation of weather reports and weather maps.

APPLIED MATHEMATICS

331. Theoretical Mechanics. J. L. Synge.

Department 5, III Year; 1 hr. per week, both terms.

The course deals with the dynamics of a particle on a curve and in two dimensions and the dynamics of rigid bodies in two-dimensional motion.

Text-book: Dynamics—Lamb.

332. Differential Equations of Mathematical Physics. A. F. Stevenson.

Department 5, IV Year; 2 hrs. per week, both terms.

The course deals with the underlying theory and with important particular equations, and includes separation of variables, eigenvalues and eigenfunctions, Fourier series, Laplace's equation, Bessel's equation, wave equation (including vibration of strings and membranes, sound waves, electromagnetic waves), equation of heat conduction, Green's function, introduction to integral equations.

333. Theory of Elasticity. J. L. Synge.

Department 5e, IV Year; 1 hr. per week, both terms.

The course covers the more fundamental parts of the mathematical theory of elasticity and includes a general discussion of strain, finite and infinitesimal, and of stress, stress-strain, relations for an isotropic body, equations of equilibrium, shell or tube under pressure, torsion and flexure, strain-energy function, anisotropic bodies and cases of elastic symmetry.

334. Theoretical Hydrodynamics. J. L. Synge.

Department 5h, IV Year; 2 hrs. per week, both terms.

The course deals with the theory of the motion of perfect and viscous fluids including irrotational motion in two and three dimensions, dynamics of solids and liquids, vortices, wave motion, motion on rotating earth, viscous flow in tube and between parallel planes, Couette motion, equations of Stokes and Oseen.

335. Dynamics. B. A. Griffith.

Department 7, II Year; 2 hrs. per week, both terms.

A course in theoretical dynamics including the motion of a particle on a straight line and in a plane, simple harmonic motion, the circular pendulum, projectiles, centre of gravity, moments of inertia, motion of a rigid body about a fixed axis, impulsive motion, problems on rolling and sliding.

Text book: An Introduction to Mechanics—J. W. Campbell.

AERONAUTICS

341. Aircraft. T. R. Loudon.

Department 5h, III Year; 1 hr. per week, both terms.

This is an introductory course in which the various types of aircraft and their component parts are described. The principles of flight are gone into and an elementary discussion of aerodynamic forces and coefficients is given.

Text book: Technical Aerodynamics—Wood.

342. Aerodynamics. T. R. Loudon, M. J. C. Lazier.

Department 54, IV Year; 2 hrs. per week, both terms.

This course of lectures extends the theory of hydrodynamics to the case of theoretical determination of forces resulting from flow around an airfoil. The theory of model testing and scale effect is discussed and a complete analysis is made of conditions of longitudinal and lateral stability. The problem of the lighter than air craft is also discussed.

Text books: Aerofoil and Airscrew Theory—Glauert. Technical Aerodynamics—Wood. Airplane Design—Warner.

344. Airplane Design and Stress Analysis. T. R. Loudon, C. F. Morrison.

Department 5h, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, both terms.

The more advanced theory of structural design is gone into as a continuation of Course 7, III Year. The properties of materials used in aircraft construction are discussed; and problems are worked out on the design of aircraft for given aerodynamic and structural specifications.

Text books: Technical Aerodynamics—Wood. Airplane Structures—Niles and Newell.

345. Hydrodynamics. R. W. Angus, T. R. Loudon, G. R. Lord, M. J. C. Lazier.

Department 5h, IV Year; 6 hrs. laboratory per week, both terms.

This course is intended to amplify the lecture courses on hydrodynamics and aerodynamics. The calibration and practical use of wind tunnel instruments is explained, and a series of experiments is carried out on the determination of forces and moments acting on various airfoil arrangements.

SECTION X. EXAMINATIONS

ANNUAL

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in all subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations are 50 per cent. in the Department of Engineering Physics and 40 per cent. in all other Departments, with an average of 50 per cent. The pass marks required in the laboratory work of all Departments are 60 per cent. In the Department of Engineering Physics an average of 60 per cent. will be required in the written and practical work of the Second, Third and Fourth Years. Candidates who have attained the required average and who have failed in not more than two subjects will be required to pass supplemental examinations in those subjects to secure pass standing.

5. Honours will be granted to students who, at the annual examinations, obtain at least 50 per cent. in each written subject, at least 60 per cent in each laboratory subject, and 75 per cent. of the total number of marks allotted to the subjects of their course.

6. Honour graduate standing will be granted to those who obtain honours in the final and in one previous year.

7. Candidates who fail to secure promotion in any year will be required to take again the whole course of instruction of the year in which they fail before presenting themselves a second time for examination.

8. A student failing in the First or Second Year of the Department of Engineering Physics will not be permitted to repeat the year in this Department.

9. A student who, in either term of the session, fails to perform satisfactorily the work of his course may not be allowed to present himself at the final examinations of the year.

10. A student should submit to Council immediately after its occurrence evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day ot examinations.

11. A student who has failed to complete satisfactorily the course in Physical Training prescribed for the First Year will not be permitted to register in the Third Year; and the student who has failed to complete satisfactorily the course in Physical Training prescribed for the Second Year will not be permitted to register in the Fourth Year.

12. A student will not be allowed to write any examination if he has not paid all fees and dues for which he is liable at that time.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on the 15th day of September, 1936. Application (on the prescribed form) to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 15th, and the fee named in Sec. VI, para. 5 received by the Bursar not later than September 1st. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements. Arrangements will be made to conduct supplemental examinations at the Survey Camp for those students in attendance at the camp.

2. If a candidate desires to write upon an annual examination as a supplemental, his application must be received by the Secretary and his fee by the Bursar, for the January examinations not later than December 1st and for the April examinations not later than March 1st.

3. Pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

SECTION XI. SCHOLARSHIPS

Through the generosity of friends of the University, encouragement has been given to both undergraduate and graduate work in its various branches, by establishing the following scholarships, prizes, bursaries and medals.

Name	Years eligible	Amount	See page
Baptie Scholarship	I	$100	126
Harvey Aggett Memorial Scholarship	II	$75	127
Boiler Inspection & Insurance Co. Scholarship	III	$150	127
Jenkins Scholarship	III	$100	127
B.A.A.S. Medal	IV	....	128
Toronto Architectural Guild Medal	V	....	128
O.A.A. Scholarship	II	$100	128
Toronto Brick Company Prizes	IV	$75 & $25	128
Darling and Pearson Prize	V	$100	128
Mathers and Haldenby Prize	III	$25	128
Heating and Ventilating Engineers Prize	III, IV	$25	129
E. I. C. Prize	III	$25	129
Canadian Engineer Prize	III, IV	$50	129
Ceramics Scholarship	III	$50	130
MacLennan-MacLeod Memorial Prize	I	$25	130
J. A. Findlay Scholarships	III, IV	....	130
R.A.I.C. Medal	V	....	131
Rhodes Scholarships	II, III, IV	£400	131
Ubukata Fund	All	....	132
F. W. Jarvis Bursaries	All	$50	132
U. of T. War Memorial Scholarship	All	$250	133
U. of T. War Memorial Fellowships	Graduate	$500	133
McCharles Prize	All & Grad.	$1,000	134
1851 Exhibition Science Research Scholarship	Graduate	£250	135
Nipissing Mining Co. Research Fellowship	Graduate	$1,100	136
Elizabeth Speller Memorial Fund	III, IV	....	136
Engineering Society Loan Fund	....	....	137

NOTE: On account of the continued tendency towards lower rates of interest it is possible that the value of certain scholarships or prizes at the time of payment may prove to be less than the amount stated in the calendar.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that from the income therefrom a scholarship of One Hundred

Dollars shall be awarded to engineering students on the record of their first year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the Annual Examinations of the First Year, enrolled in any one of the departments of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those departments. The first award was made on the results of the annual examinations of the Session 1925-26.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of Seventy-five Dollars is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a Scholarship in the Department of Mechanical Engineering of the value of One hundred and fifty Dollars to the student who obtains highest Honour Standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Bursar to the fees of the Fourth Year of the successful candidate.

JENKINS SCHOLARSHIP IN ENGINEERING

The Jenkins Scholarship in Engineering, presented by Jenkins Bros., Limited, has been donated to continue for a period of fifteen years, the first award having been made in 1925.

This annual scholarship, of the value of One Hundred Dollars, is to be awarded to the student of the Third Year registered in one of the six departments of Civil, Mining, Mechanical, Chemical, Electrical or Metallurgical Engineering, who has the highest aggregate of percentages for the First, Second and Third years.

B.A.A.S. MEDAL

A bronze medal has been donated for students of the Faculty of Applied Science and Engineering by members of the British Association for the Advancement of Science. This Medal will be awarded to the student of the Fourth Year, in any department, who, taking honours, obtains the highest aggregate percentage in practical and written examinations in the year.

TORONTO ARCHITECTURAL GUILD MEDAL

The Toronto Architectural Guild was the organization of local architects from which sprung the Ontario Association of Architects. When the new and wider association became firmly established, the Guild disbanded and handed over to a trustee board certain funds for the establishment of a medal to be awarded in the School of Architecture of the University of Toronto.

The Trustee Board, now that the fund has accumulated considerably, announces its intention of awarding this medal annually to a senior student showing outstanding ability in Architectural Design.

ONTARIO ASSOCIATION OF ARCHITECTS SCHOLARSHIP

The Ontario Association of Architects offers a scholarship of One Hundred Dollars to the student of the Second Year in the School of Architecture who at the annual examinations obtains the highest honour standing in Architectural Design. The scholarship was awarded annually from 1928 to 1935 inclusive and has been extended for a further period of five years.

TORONTO BRICK COMPANY PRIZES

The Toronto Brick Company offers two prizes, one of Seventy-five Dollars and one of Twenty-five Dollars to those students of the Fourth Year in the School of Architecture who win first and second places in a competition arranged by the Staff in the School of Architecture for this purpose.

DARLING AND PEARSON PRIZE IN ARCHITECTURE

Messrs. Darling and Pearson, Architects, offer annually a prize of One Hundred Dollars in books to the student in the final year of the School of Architecture who is assigned the highest marks in a special problem in Architectural Design, set for this purpose by the School of Architecture. The books constituting this prize are to be selected by the successful candidate, with the approval of the School of Architecture.

The first award of this prize was made in the Session 1927-28.

MATHERS AND HALDENBY PRIZE

Messrs. Mathers and Haldenby, Architects, offer annually for five years (1933-1937 inclusive), as a prize to the student of the Third Year, School of Architecture, who is awarded the highest honour standing for

the set of measured drawings handed in at the beginning of the session as his Vacation Work, books to the value of twenty-five dollars to be selected by the donors.

HEATING AND VENTILATING ENGINEERS PRIZE

The Ontario Chapter of the American Society of Heating and Ventilating Engineers offers an annual prize of Twenty-five Dollars for a period of five years commencing 1931. The period was extended indefinitely in 1935. The prize will be awarded to the student in either the Third of Fourth Year in the Department of Mechanical Engineering who, in the opinion of that Department, has written the most satisfactory thesis on subjects dealing with Heating and Ventilation, such thesis being prepared under special arrangement made by the Department, the result to be reported to Council at the time of the annual examination results. The thesis must be handed in not later than March 1st. The prize will not necessarily be awarded in any year.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional knowledge among its members, offers an annual prize of Twenty-five Dollars in this University, to continue for a period of five years, commencing 1931, to the student who in his Third Year in any one of the six Departments of Engineering has proved himself most deserving as disclosed by the examination results of the year in combination with his activities in the Engineering Society, or with a local branch of another recognized engineering organization. This prize was extended in 1935 for a further period of five years.

CANADIAN ENGINEER PRIZE

An annual prize of Fifty Dollars is offered by the publishers of "The Canadian Engineer" for the best thesis submitted by a student of any Department of Engineering in the Third or Fourth Year, on a subject pertaining to highway construction, water supply, water purification, sewage disposal, hydraulic works, railway engineering, canals, harbours, structures, or foundations. Each candidate is required to obtain approval of the subject from the head of the Department in which he is registered and must submit his completed thesis to the Secretary of the Faculty not later than March 1st. The examination and grading of the theses will be carried out under arrangements made by the Faculty Council. An award will not necessarily be made in any year. The first award was made at the annual examinations, 1931.

The thesis should not be shorter than four thousand words, nor in excess of six thousand words, and may be accompanied by illustrations.

Only five awards of the prize having been contemplated by the donor, if the award is made in 1936 the prize may not be available thereafter.

CERAMICS SCHOLARSHIP

The Canadian Ceramic Society offers an annual scholarship of the value of Fifty Dollars for a period of ten years commencing 1932, to be known as "The Ceramics Scholarship." The scholarship will be awarded to the student in the Third Year in the Department of Metallurgical Engineering enrolled in the Ceramics Option, who has obtained the best academic standing. An award will not necessarily be made in any year.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize to the value of Twenty-five Dollars, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year Student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the Annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. In any year in which no award is made, the income from the prize for that year will be available for a second award in any subsequent year.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available to students in this Department, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award will be made to another eligible student.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA MEDAL

The Royal Architectural Institute of Canada has presented a medal to be awarded annually to a member of the graduating class in the School of Architecture, who having completed the requirements for the degree, has obtained high standing throughout his course and gives promise of being an architect of distinction after graduation. The person to whom the award is made must be a British subject; he must have completed the entire course in Architecture in the School of Architecture of the University of Toronto, except in the case of a graduate of the Royal Military College who shall have completed at least the Third, Fourth and Fifth Years in the School; he must have obtained high standing throughout his course, particularly in Architectural Design, and his character, personality and intellect must be such as to indicate that in the practice of his profession, he may be expected to attain distinction. No award will be made in any Session in which the Council of the Faculty of Applied Science and Engineering so recommends.

RHODES SCHOLARSHIPS

A Rhodes Scholarship is tenable at the University of Oxford and may be held for three years. Since, however, the majority of Rhodes Scholars obtain standing which enables them to take a degree in two years, appointments are made for two years in the first instance, and a Rhodes Scholar who may wish to remain for a third year will be expected to present a definite plan of study for that period satisfactory to his College and the Rhodes Trustees.

Rhodes Scholars may be allowed, if the conditions are approved by their own College and by the Oxford Secretary to the Rhodes Trustees, either to postpone their third year, returning to Oxford for it after a period of work in their own countries, or to spend their third year in postgraduate work at any University of Great Britain, and in special cases at any University on the continent of Europe, the Overseas Dominions, or in the United States, but not in the country of their origin.

The stipend of a Rhodes Scholar is fixed at £400 per year. At most Colleges, and for most men, this sum is not sufficient to meet a Rhodes Scholar's necessary expenses for term-time and vacations, and Scholars who can afford to supplement it by say £50 per year from their own resources will find it advantageous to do so.

The Rhodes Scholarship is open equally to students in all faculties. A candidate to be eligible must:

1. Be a British subject, with at least five years' domicile in Canada, and unmarried. He must have passed his nineteenth, but not have passed his twenty-fifth birthday on October 1st of the year *for* which he is elected.

2. Have reached such a stage in his course at one of the Universities of Canada that he will have completed at least two years at the University in question by October 1st of the year *for* which he is elected.

Candidates may apply either for the province in which they have their ordinary private domicile, home, or residence, or for any province in which they have received at least two years of their college education before applying. Full particulars can be obtained from Henry Borden, Esq., 320 Bay Street, Toronto 2, Secretary of the Selection Committee for the Province of Ontario.

Two scholarships may be awarded annually in the Province of Ontario if qualified candidates appear. Each candidate for a scholarship is required to make application to the Secretary of the Committee of Selection of the province in which he wishes to compete, *not later than November 10th*, using the application form to be obtained from the Secretary, and furnishing the material there specified.

3. Basis of Selection. In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments.

(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship.

(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his schoolmates.

(4) Physical vigour. as shown by interest in outdoor sports or in other ways.

Distinction, both in character and personality and in intellect, is the most important requirement for a Rhodes Scholarship. Success in being elected to office in student organizations may or may not be evidence of leadership in the true sense of the word. Mr. Rhodes evidently regarded leadership as consisting in moral courage and in interest in one's fellow men quite as much as in the more aggressive qualities. Physical vigour is an essential qualification for a Rhodes Scholarship, but athletic skill is of less importance than the moral qualities developed in playing outdoor games.

UBUKATA FUND

The S. Ubakata Fund, the gift of Mr. S. Ubakata, of the value of $10,000, provides for the establishment of prizes, medals, scholarships and loans for which Japanese students of all faculties and colleges may be eligible. Information and special application forms may be obtained from the Registrar of the University, to whom applications must be returned on or before December 1st.

F. W. JARVIS BURSARY

A bursary known as "The F. W. Jarvis Bursary", the gift of A. H. Jarvis, Esq., of Ottawa, brother of F. W. Jarvis, of the value of $50, to be awarded under the following conditions:

1. The bursary is open only to former students of Ottawa Collegiate Institute (Lisgar Street), who without some such assistance may not be able to carry on their academic courses.

2. It may be awarded at Matriculation or in any year of an undergraduate course in any Faculty of the University.

3. A bursary may be held in successive years by the same student and also in conjunction with any scholarship awarded by the University or the federated colleges.

4. The bursary shall be awarded by the Senate of the University on the recommendation of a Committee of Award consisting of the President of the University, the Principal of Ottawa Collegiate Institute and the donor; candidates shall make application for the same not later than May 15th on the special form to be obtained from the Registrar.

UNIVERSITY OF TORONTO WAR MEMORIAL SCHOLARSHIPS

Four scholarships, each of the value of Two Hundred and Fifty Dollars, have been established by the Alumni Federation of the University from the War Memorial Fund to be awarded to students in the Faculties of Applied Science and Engineering, and Forestry.

The general basis on which scholarships may be awarded shall be as follows: (*a*) Standing in course of studies. (*b*) Need of assistance. (*c*) Merit as shown in extra-academic activities—executive, literary, dramatic, athletic, etc. (*d*) Relationship, if any, to active service during the War.

Information regarding these scholarships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., to whom application must be made not later than April 15th.

UNIVERSITY OF TORONTO WAR MEMORIAL FELLOWSHIPS

Two Fellowships of the value of $500 each, in the School of Graduate Studies of the University have been established by the Alumni Federation of the University of Toronto from the War Memorial Fund, to be awarded to graduates of any approved university in the Dominion of Canada enrolled, or intending to enrol in the School of Graduate Studies, for the purpose of proceeding to a degree in any department of the University of Toronto. The general basis of award is as follows:

(*a*) Standing at Graduation or in previous year of postgraduate work.

(*b*) Such other general qualifications of merit as may commend themselves to the Committee, including relationship (if any) to active service during the War.

Information regarding these fellowships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., Toronto, to whom applications, accompanied by an official statement of undergraduate standing, should be made before April 15th.

The War Memorial Fellowships are accompanied by the remission of tuition fees by the University for the Session 1936-37.

McCHARLES PRIZE

This prize was established in connection with the bequest of the late Æneas McCharles of Provincial Government bonds of the value of $10,000, and is awarded on the following terms and conditions, namely, that the interest therefrom shall be given from time to time, but not necessarily every year, like the Nobel prizes in a small way: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions, as passed by the Board of Governors, determine the method of award:—

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000.00) in money.

(3) The term "Canadian" for the purpose of this award shall mean any person Canadian born who has not renounced British allegiance; and for the purpose of the award in the first of the three cases provided for by the bequest, domicile in Canada shall be an essential condition.

(4) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(5) No prize shall be awarded for any discovery or invention unless the same shall have been proved to the satisfaction of the awarding body, to possess the special practical merit indicated by the terms of the bequest.

(6) The order of priority in which the three cases stand in the wording of the bequest shall be observed in making the award; that is, the award shall go *caeteris paribus* to the inventor of methods of smelting Canadian ores; and, failing such inventions, to the inventor of methods for lessening the dangers attendant upon the use of electricity; and only in the third event, if no inventors of sufficient merit in the field of metallurgy and electricity present themselves, to the inventor distinguished in the general field of useful scientific research.

(7) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIP

The Royal Commissioners for the Exhibition of 1851, if satisfied with the qualifications of the candidates put forward, will each year allot three Science Research Scholarships to Canada. The University of Toronto has been invited to recommend annually one or more candidates in order of merit for these scholarships.

1. Each candidate recommended must be a British subject and under twenty-six years of age, except in very special circumstances; he* must be a bona fide student of Science of not less than three years' standing; he must also have completed a full University course and have spent at least one full academic year at this University ending not more than twelve months prior to the date of recommendation.

2. The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

3. Applications for these scholarships must be made to the Registrar of the University not later than April 15th; the latest date on which the recommendation of the University of Toronto for scholarships offered in 1936 can be received at the Office of the Commissioners is June 1st, 1936.

4. Each scholarship is of the value of £250 per annum, payable quarterly in advance; on presenting to the Commissioners a satisfactory final report at the expiration of his scholarship the scholar will receive a grant of £25. A scholar who is not in a position to travel at his own expense, or for whom it is not possible to obtain free passage, may make application to the Commissioners for aid towards the payment of his fare from his home to his place of study. A scholar may receive an additional annual allowance, not exceeding £30, towards the cost of University fees, if, in the opinion of the Commissioners, he is in need of such allowance.

5. The scholarship will be tenable ordinarily for two years, and in cases of exceptional merit for three years. The continuation of a scholarship for a second year will depend upon the satisfactory nature of the scholar's first year's work. Renewal for a third year will be granted only where it appears that the renewal is likely to result in work of scientific importance.

6. The scholar will be required to devote himself to research in some branch of pure or applied science, the particular nature of the work proposed to be approved by the Commissioners.

7. A scholarship may be held, with the approval of the Commissioners,

**Women are also eligible for the awards.*

at any Institution in the United Kingdom or abroad, but a scholar will not be permitted, except under very special circumstances, to conduct his investigations in the country in which he has received his scientific education.

8. Scholars will be required to furnish reports of their work at the end of each year of tenure of their scholarships.

9. Scholars will be required to devote their whole time to the objects of the scholarship, and will not be permitted to hold any position of emolument which carries with it a duty inconsistent with their obligation to the Commissioners. Scholars must in any case obtain the consent of the Commissioners before accepting any additional emoluments.

The regulations adopted by the Senate are as follows:—

The departments, students of which shall be eligible to be candidates, are:—1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geology; 13. Mineralogy; 14. Physics; 15. Physiology; 16. Zoology.

A student shall not be deemed to be ineligible because of his being on the teaching staff of the University, if he has not been in receipt of a salary of more than $800 per annum and has not been on the teaching staff for more than two years from graduation.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nomination of the candidate or candidates shall be made by a Board composed of seven members appointed by the Senate, and the Board shall consist of the Chancellor, the President, Chancellor E. W. Wallace, the Honourable Mr. Justice Masten, Dr. De Lury, Dr. C. S. MacInnes, and Dean Brett, and the Board shall have power to call to its aid as assessor any member of the teaching staff.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering to be known as The Nipissing Mining Company Research Fellowship, of the annual value of Eleven Hundred Dollars.

This Fellowship is open to the graduates of any University.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller of the class of 1893 the "Elizabeth Speller Memorial Fund" has been established, the annual income from which is available for loans to worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary.

SECTION XII. LIBRARIES AND LABORATORY EQUIPMENT

LIBRARIES

THE UNIVERSITY LIBRARY

The University Library building is situated on the east side of the lawn that lies to the south of University College. It contains reading-rooms for men and for women, a law reading-room, and a medical reasing-room, besides departmental studies which may be used as study rooms for honour students in the various depratments in which the professors hold seminary courses, and private studies intended for advanced students engaged in research work.

The University Library building is opened at 8.45 every morning, and remains open until 10 o'clock in the evening, during the academic term. Books in ordinary use may not be taken out of the Library building or from the reserved book reading-rooms during the day-time, but are lent for the night toward 3 p.m., to be returned the following morning not later than 10 o'clock. Books not in general demand, may on application be borrowed for a longer period.

DEPARTMENTAL LIBRARIES

Periodicals and other literature in the University Library of special interest to the students of this faculty have been housed in the Electrical, Engineering, Mechanical and Mining Buildings for convenient reference.

These departmental libraries are situated as follows:

Applied Physics	Room 22, Engineering Bldg.
Architecture	Room 37, Engineering Bldg.
Chemical Engineering	Room 53½ Mining Bldg.
Civil Engineering	Room 25, Electrical Bldg.
	Room 22, Engineering Bldg.
Electrical Engineering	Room 25, Electrical Bldg.
Mechanical Engineering	Room 17, Mechanical Bldg.
Metallurgical Engineering	Room 37, Mining Bldg.
Mining Engineering	Room 314, Mill Bldg.

AERODYNAMIC LABORATORY

The Aerodynamic Laboratory is fully equipped with an improved 4-ft. Royal Aircraft Establishment type wind channel, aerodynamic balance, micromanometers and other necessary instruments.

Air speeds of 80 feet per second can be secured in a stream of great steadiness and uniformity and higher speeds with some sacrifice in steadiness.

The work done in the Laboratory includes the investigation of problems in aerodynamics, tests of air craft components, and complete machines, rating of meters, ventilators, radiators, etc., and the study of the effect of wind pressure on structures, chimneys, etc.

ASSAYING LABORATORIES

The Fire Assaying Laboratories are situated on the top floor of the new Mill Building. The East and West laboratories are identical and consist of preparation, furnace and balance rooms. Between and common to these is a supply room and another for the wet work in connection with the subject. The arrangement is such as to allow a natural flow of operations from preparation of the product to be assayed to the final weighing.

The preparation rooms are equipped with a Sturtevant crusher, McCool pulverizer, buck boards, samplers, cupel machines and screens. A special laboratory sampler has been constructed, for the purpose of giving samples for the students' assays, of indisputable similarity, thus confining variations in results to their work.

The furnace rooms have six Fletcher-Russell Perfected gas furnaces supported on concrete pouring tables, and two Denver Fire Clay oil-burning type. Each working table has its own balance, also a locker and drawers for fluxes, weights and tools.

The balance rooms face the north light. Protection from dust and fumes is afforded by double entrance doors. The bead balances are supported on a concrete slab resting on brick piers insulated by cork to absorb vibration. The balances are illustrative of the types met in practice, the following makers being represented—Ainsworth, Becker, Heusser, Keller, Oertling, Thompson and Voland. Some have a sensitivity of $\frac{1}{500}$ milligram.

Realizing the importance of storing fluxes, free from contamination, these are kept in an inner storeroom off the main supply room which houses clayware, and general stores. Remote from here is the ore storage room containing a large number of ores, matte, bullion and alloys, obtained chiefly from typical mining districts and metallurgical plants.

Undergraduate research is carried on in the Thesis room. This has coal and gas furnaces. Other apparatus is supplied to suit the investigations undertaken. A study room is always available.

Contiguous to the staff rooms are two equipped for research and the determinations required for instructional purposes. A Hoskins electric resistance furnace is installed, also a Leeds-Northrup controller and recorder. Other equipment includes optical, resistance and thermocouple pyrometers, microscopes, drying oven, Guess-Haultain stationary electrolytic outfit, King rotating electrolytic apparatus, and bullion rolls.

CEMENT TESTING LABORATORY

This laboratory is fitted with all the ordinary moulds, sieves, balances, burettes, steaming and drying tanks, tables, and other appliances necessary in making the usual physical tests of a Portland cement. It is also supplied with completely equipped cabinets for individual work. In addition there are the following:

A 2,000 lb. Riehlé shot machine for tension.

A 2,000 lb. Fairbanks shot machine for tension.

A 1,000 lb. Olsen automatic shot machine fitted for tests in either tension or cross breaking.

An Olsen soapstone moist closet.

CHEMICAL LABORATORIES

The Chemical Laboratories are situated in the western half of the Chemistry and Mining building, in the basement, first and second floors. The rooms are large and well lighted, and are supplied with the usual modern equipment.

Instruction in general chemistry and in elementary quantitative analysis is given in a large laboratory on the second floor, accommodating 84 students, each working place being supplied with water, gas and fume cupboard. Two adjoining laboratories, with provision for 50 students, are set aside for the use of the Second Year in the course in Chemical Engineering, while two other laboratories, with 36 and 48 working places, are used jointly by the Third Year in Chemical Engineering and by other students in Mining and Metallurgy, and also by the Department of Chemistry, Faculty of Arts. Fourth Year students in Chemical Engineering are accommodated in a laboratory which has provision for 20 men engaged in research work. Each of these laboratories has its own balance room adjoining, furnished with instruments from the best makers and adapted to the particular objects in view.

In addition there are seven small rooms set apart for research, a room for gas analysis and a specially constructed fireproof laboratory for combustion and bomb furnaces. Each of these is well equipped and offers excellent facilities for the prosecution of research, as well as for work of a technical character.

ELECTRICAL LABORATORIES

The Department of Electrical Engineering is located in the Electrical Building. The accommodation includes quarters for staff, library, lecture rooms, laboratories, stores, and shop for repairs and construction.

Services.—Three-wire direct-current, 110 kw., from the University power house, automatically regulated at our end for constant voltage of desired value at our main switchboard. Three-phase, 60 cycles, 60 k.v.a., 115 volts, automatically regulated as to voltage and frequency. Three-

phase, 25 cycles, 30 k.v.a., automatically regulated as to voltage and frequency. Every laboratory has all three services available at convenient places. There are three main boards, one for each floor. A system of special trunk lines between boards, and tree systems on each floor, enable easy arrangement of any desired special connections from any laboratory to any other.

Alternating current laboratory.—Area 26 x 110 ft., service sets 60 and 25 cycles, Tirrill regulators. Two 60-cycle and two 25-cycle, 15 k.v.a. motor-generator sets; converters: various motors, squirrel cage and wound rotor induction types, repulsion and other single-phase types, unity power factor motor, polyphase motor with variable speed shunt characteristics and speed range of 4 to 1; transformers, single and three-phase; constant-current transformers with load of series arc lamps; lamp racks, reactors, condensers, brakes, etc.; oscillographs; indicating, graphic, recording, and demand meters of the best makes; all arranged to facilitate a very general line of experimental work.

Direct current laboratory.—40 kw. 230 to 115 volt motor generator set with Tirrill regulator for special tests. Numerous 5 kw. to 10 kw. motor-generator sets; shunt, series, compound motors; special interpole machines; loading racks, dynamometers, rheostats, numerous meters of first quality, etc., for any sort of study.

Measurements Laboratory.—26 x 110 ft. Fitted with very flexible storage battery service which can be connected to any desired working place; d.c. three-wire service, also 60 and 25-cycle three-phase everywhere; galvanometers, resistance boxes, bridges, shunts, potentiometers, standard cells, bond testers, ductor, megger, apparatus for measuring low resistances, artificial lines for fault measurements, condensers, inductances, rails, cables, voltmeters, ammeters, wattmeters, dynamometers, etc., for general work on a great variety of measurements.

High voltage laboratory.—For various lines of study with voltages up to 200,000 volts. Flexible and safe provision for control.

Materials laboratories.—One specially fitted for general work on conducting materials, one for magnetic materials, one for dielectric materials.

Radio laboratory.—Adapted for the measurement of various quantities of interest in this work, including the strength of incoming signals. One single conductor aerial 1,000 ft. long, one multi-conductor aerial 120 ft. long.

Standardizing laboratories.—One students' calibration room for direct-current meters, another for alternating-current meters. A standards room, constant temperature, for master standards of voltage, resistance, current, power, etc.

Research laboratories.—Four rooms set apart for this work, in combination with facilities of the other laboratories.

Design laboratory.—Arranged for calculation work on apparatus selected to illustrate essential principles.

ELECTROCHEMICAL LABORATORIES

The Electrochemical laboratories, which are situated in the Mining Building, are provided with special facilities for electrolytic work, including a large storage battery and electroplating dynamo with tanks as well as a good set of apparatus and electrical measuring instruments. The experimental work on electric furnaces is carried out in a large furnace room in the basement, occupied jointly by this Department and the Department of Metallurgy. The equipment for this purpose comprises a 120 KW, 220 volt supply of direct current from the main power house through a switchboard, rheostats, circuit-breaker and instruments to a set of distributing bus-bars, and a 200 KV-a transformer stepping down from 2200 volts to 30-120 volts in 3 and 6 volt steps, which supplies alternating current at 25 cycles. There is a complete set of A.C. instruments, circuit-breakers, oil-switches, relays, automatic regulating winches, etc., and a Northrup high frequency furnace with its transformer is also installed.

APPLIED PHYSICS LABORATORIES

The Applied Physics laboratories, situated in the Engineering Building, are equipped as follows:

The Photometric Laboratory is equipped with precision and portable photometers for the measurement of candle-power, illumination, and brightness, integrating spheres for determining the luminous output and efficiency of lamps and lunmiaires, and colorimeters, spectro-photometers and flicker photometers for the measurement of colour. Standards of candle power, luminous flux and colour temperature are maintained and a 132 volt storage battery with all electrical controls and meters necessary for precise photometry are provided.

The Illumination Design Laboratory is equipped for demonstrating and measuring the performance of lighting installations.

The Optics Laboratory is equipped with optical benches, etc., for the testing of lenses and examples of various optical instruments for instruction in their theory and applications.

The Photographic Laboratory is equipped with cameras, darkrooms and accessories for practical work in photography, and with sensitometers, spectrographs and densitometers for the testing of photographic materials. A Zeiss phototheodolite, stereoscope, stereo-comparator and plotting apparatus are provided for instruction in photographic surveying.

The Acoustical Laboratory is equipped with the ordinary apparatus for illustrating the elementary laws of acoustics, that is, forks, pipes, conometers, etc. There are also two rooms intended for work in sound transmission and absorption. The equipment of these consists of a four octave organ for the production of sounds of constant intensity and a microphone and amplifier circuit for reception. There is also an oscillator and dynamic loud apeaker as an alternative to the organ.

The Heat and Hydrostatics Laboratory is equipped for experiments on thermometry, calorimetry, thermal expansion, heat transmission, etc., and for work with hydrometers, manometers, barometers and the determination of specific gravity.

GEOLOGICAL AND MINERALOGICAL LABORATORIES

In the Mining building on College Street the University possesses a modern laboratory for Geology and Mineralogy.

Courses are given in laboratory work, especially in personal examination of type sets of rocks, fossils, minerals and crystal models. These laboratory exercises serve to illustrate the introductory didactic instruction.

For the encouragement of pure crystallography the laboratories are supplied with goniometers of the various types, crystal models, appliances for the cutting of oriented crystal sections and for the physical examination of the same. Practical petrography is carried on in rooms provided with type sets of rocks, both macroscopic and microscopic. Advanced students are taught to make thin sections of rocks and fossils and to study them microscopically. For students in Mining a laboratory course in the interpretation of geological maps and sections is provided. Typical mining regions are studied in detail and an opportunity is afforded for the examination of specimens illustrating economic geology.

The laboratory for the preparation of thin sections of rocks, minerals and fossils is provided with electric diamond saws and grinding appliances for the various types of work incidental to the preparation of thin sections and museum material.

A room is also provided for advanced work in cartography and geological surveying.

The departments possess 40 petrological microscopes and 10 of other types, so that it is now possible to provide advanced students with instruments and sets of thin sections for their own special use. The blowpipe laboratory contains 156 lockers, especially designed for apparatus for students. Provision is made for the study of opaque minerals in reflected light.

HIGHWAY LABORATORY

ROAD METALS AND SUBGRADE SOILS

This laboratory is equipped for carrying out investigations in the various materials employed in highway construction and maintenance, and comprises the following:

A Page impact machine for testing the toughness of road materials.

A diamond core drill for preparing specimens for the toughness test.

A Deval abrasion machine for testing the resistance to wear of road materials.

A cementation testing apparatus (Page type) for determining cement in properties of road materials.

A jaw crusher (Mitchell type) for crushing rock for various tests.

A power driven agitator with sieves for the mechanical analysis of sand, gravel and crushed rock.

A Dorry hardness testing machine for determining the hardness of rock used in road construction.

A Riehlé standard brick-rattler.

A mechanical centrifuge for determining moisture equivalent of soils and apparatus for determining volumetric changes, capillary moisture and other properties of subsoils of interest to the highway engineer.

A Hamilton Beach dispersing machine and a Bouyoucos hydrometer for determining soil analysis.

BITUMENS

This laboratory is designed for the investigation of the physical rather than the chemical properties of bitumens used in road construction and maintenance. The equipment consists of an extractor for separating bitumens and aggregates, an Engler viscosimeter, a penetration apparatus as well as appliances for determining melting point, volatilization, specific gravity, ductility, etc,

HYDRAULIC LABORATORY

The hydraulic laboratory occupies two floors each 40 feet x 112 feet, which are well lighted by large windows on the side and end.

The water for the experimental work is pumped through the various pieces of apparatus from a well by means of two turbine pumping units, both of which are driven by a Belliss and Morcom compound engine of 125 h.p. running at a speed of 525 revs. per minute. Both engine and pumps have been installed with a view to using them in experimental work as well as for supply of water for other apparatus used in the laboratory.

The pumping units are capable of delivering one cubic foot of water per second against heads of 250 feet and 300 feet respectively. These units are designed and connected up so that they may be run in series giving the above discharge at 550 feet head, or they may be run in parallel giving double the discharge at a lower head. Each pumping unit consists of two two-stage pumps mounted on a common base and driven by a single pulley, and the construction and piping are such that each two-stage pump may be driven separately or that all may be driven at once, discharging separately one cubic foot per second at about 125 feet head through each of four independent pipes, or else the pumps may be run in series or in parallel. The scheme is thus well adapted to laboratory work, and under the heads used on reaction turbines about six cubic feet per second may be obtained.

In addition to this there is an electrically driven pump capable of delivering six cubic feet per second at a head of sixty-five feet and which is most helpful in turbine testing. Attention is called to the special turbine testing flume described below.

The laboratory further contains a large vertical steel tank $5\frac{1}{2}$ feet diameter by 34 feet, with arrangements for the attachment of nozzles and other mouthpieces, etc. Connections are also arranged for reaction turbines, the tank acting as a reservoir.

The discharge from the turbines or nozzles is measured in a weir tank nearly 6 feet wide and 21 feet long, containing a contracted weir $4\frac{1}{2}$ feet wide. This weir may be calibrated by two weighing tanks, each having a capacity of about 240 cubic feet.

There are three reaction turbines and two impulse wheels all ready for experiment, the power being measured by brakes and the water by weir or orifices. Amongst the reaction turbines may be mentioned the one designed and built by Escher Wyss & Co., specially for the laboratory.

A new and specially designed turbine testing flume has recently been added to the laboratory, the machinery for which has been largely furnished through the kindness of the Dominion Engineering Works, Montreal, and Wm. Cramp and Sons, Philadelphia. This flume is supplied with water by a Moody spiral pump of twelve cubic feet per second capacity and at present there are two turbines, one of the propeller type, and also two special draft tubes and more will be added. This provides an excellent opportunity for experiment and research.

A Kaplan turbine has also been installed.

Smaller orifice and weir tanks, each about 3 x 3 x 12 feet with necessary measuring tanks, are arranged for instruction in coefficients of various kinds and practice with weirs and orifices.

A Venturi meter and other meters, also an hydraulic ram and similar devices are available for testing, and good facilities have been arranged for investigating friction and other properties of pipes and fire hose.

For special investigations on turbine and centrifugal pumps, other pumps in addition to those already described have been arranged.

The basement of the laboratory contains an open trough 5 feet wide, about 110 feet long, with a large weir at one end. It is intended to use this trough for experiments on the flow in open channels, for measurements of large discharges by means of the weir, and for experiments with current meters and Pilot tubes.

Numerous pieces of smaller apparatus, together with all instruments required, have also been provided, and the laboratory equipment is believed to be very complete. A glass trough 30 feet long has been added to the equipment.

MECHANICS OF MATERIALS LABORATORY

This laboratory is available for the scientific and commercial testing of materials of construction such as iron, steel, timber, concrete and masonry. It is supplied with the following:

A 200 ton, three-screw power testing machine, built by Riehlé Bros., Philadelphia. It will make tests in tension, compression, shear and cross-bending, and will take posts 10 feet long and beams of 16 feet in span.

A Riehlé 100 ton screw power universal testing machine, taking posts 12 feet long and beams of 18 ft. span.

A Riehlé 10-ton screw power universal testing machine.

A Riehlé 50-ton screw power universal testing machine.

A 15-ton single lever-machine, built by J. Buckton & Co., Leeds, England.

A torsion machine, built by Tinius Olsen & Co., Philadelphia, for testing the strength and elasticity of shafting. This machine will accommodate specimens up to 16 feet in length and 2 inches in diameter.

A hand power torsion machine of simple mechanical design for the testing of short shafts of a maximum diameter of one inch.

A Riehlé transverse testing machine of 5,000 pounds capacity, adapted to specimens up to 48 inches in length.

A Riehlé compressometer, with spherical seat attachment for the adjustment of specimens having slightly non-parallel faces. This compressometer will receive specimens up to 10 inches in length.

A set of Riehlé proving levers with standard weights for calibrating testing machines.

An Amsler calibrating box of 60,000 lb. capacity for calibrating testing machines.

An Olsen compression micrometer of standard type.

A 20,000 pound Olsen, hand power, wire testing machine, specially fitted for testing wooden columns with both fixed and pivoted ends.

An Olsen combined tension and cantilever type impact testing machine.

An Olsen, 20,000 pound, hand-power testing machine especially adapted for testing long columns.

An Olsen, 200 pound capacity, textile testing machine.

A Berry strain-gauge for spans of 2 inches and 8 inches and an Olsen strain gauge of the same range.

A Nalder dividing engine. This may be used either for the precise division of scales or for the calibration of instruments intended for refined measurements.

A Brinell hardness testing machine.

An Olsen Brinell proving ring, 3,000 kg. capacity, for checking the Brinell hardness tester.

A Firth hardometer with diamond and ball attachments for hardness testing.

A Shore scleroscope for testing hardness.

A Fereday-Palmer stress recorder by T. Cooke & Sons, Ltd., London.

Four Beggs deformeter gauges with necessary plugs and accessories for investigating stresses in structures by means of models.

A large number of extensometers of the usual degree of precision. These include the Bauschinger, Martens, Unwin, Ames, Riehlé, Johnson, Henning

(recording), Huggenberger and other types. In addition there are the usual scales, micrometers, telescopes and reflectors, voltmeters for the determination of metallic contact, and such other appliances as are necessary in the making of precise measurements.

The shop is equipped with a number of high-class machine tools specially fitted for reducing the specimens to the requisite shapes and dimensions with a minimum of hand labour. It is also supplied with the necessary appliances for making ordinary repairs and for making apparatus for special experiment and original investigation.

METALLURGICAL LABORATORIES

This laboratory, in the East end of the Mining Building, occupies about 3,600 sq. ft. on the basement floor and the same space immediately above on the ground floor. The basement floor is divided into one large furnace room, a small hydrometallurgical room and two store-rooms. The furnace room contains a motor driven Connersville blower, several gas fired furnaces, two small blast furnaces, and a small 6 hearth Wedge roasting furnace. The larger electric furnaces of the Department of Electrochemistry are in this room. Some are supplied with direct current, others with A.C. from a 200 K.V.A. transformer. A system of flues, with hoods over all the furnaces, leads through a Cottrell precipitator of the Rathbun type taking current at 50,000 volts, to a stack through which gases are pulled by a fan in the attic.

The hydro-metallurgical room in addition to apparatus for leaching tests contains several natural draft furnaces, a large Hoskins resistance furnace and a 113 lb. drop hammer. There are also tanks for electrolytic refining and precipitation of metals.

The upper floor is divided into laboratories, store rooms and offices. The laboratories are: 1. Metallurgical analysis; 2. Heating treatment and pyrometry; 3. Grinding, polishing and etching; 4. Metallographic room with an adjoining dark room.

In the laboratory for metallurgical analysis the student is given some training in mill and smelter methods of analysis. It is well equipped for this work.

In the heat treatment and pyrometry laboratory are a number of tube furnaces of different sizes, a Leeds & Northrup transformation point indicator with furnace, double thermocouple and twin galvanometer, a Leeds & Northrup potentiometer pyrometer, a disappearing filament pyrometer, and many thermocouples for use with galvanometer or potentiometer. For grinding and polishing there is provided two motor driven emery wheels and a set of 3 motor driven horizontal polishing plates.

The Metallographic room is equipped with the lastest type Bausch & Lomb horizontal inverted microscope type of photo micrographic apparatus, an older and horizontal photo micrographic instrument made by Pellin, Paris; two vertical photo micrographic instruments and three other metallographic microscopes.

There are also a Pellin instrument for the determination of critical points by photography according to the Saladin method, and a Leeds & Northrup type "K" precision potentiometer, which is also used for the determination of critical points.

The laboratory has a Rockwell hardness testing machine, and a wire drawing bench.

The Ceramic equipment includes:

A dry pan and a vertical pug mill.

A small dry press.

A plunger machine with tile and hollow ware dies.

An Abbé six jar ball mill.

A recuperative down draft clay testing furnace of brick construction.

An oil fired muffle decorating kiln.

A small Seger test furnace.

A high temperature oxygen acetylene furnace.

A high temperature electric muffle furnace with a temperature range up to 1700°C.

Standard screens, volumeters, elutriation apparatus driers and such sundries as are necessary for clay testing.

METROLOGICAL LABORATORY

The department of surveying and geodesy is provided with all the ordinary field instruments, such as transits, levels, compasses, micrometers, sextants, planimeters, plane tables, tapes, chains, etc., with which is carried on the instruction in practical field operations as detailed elsewhere.

A small laboratory is also established in the basement of the observatory described below, containing the necessary instruments for the refined measurements of geodetic surveying; as, a standard yard and metre, a Rogers 10-foot comparator, an invar base measuring apparatus, a Kater's pendulum with vacuum chamber, a level trier, micrometer microscopes, etc.

The geodetic observatory in connection with this department is used for the instruction of students of the Fourth Year in taking observations for time, latitude, longitude, and azimuth by the precise methods used in connection with a geodetic survey. It contains a 10-inch theodolite and zenith telescope by Troughton & Simms; an astronomical transit instrument and an 8-inch theodolite by Cooke; two electro-chronographs; a Howard astronomical clock; a Dent sideral clock; a Dent sideral break-circuit chronometer; a wireless receiving instrument; arithmometers, etc.

MINING AND ORE DRESSING LABORATORIES

During 1931 the building containing these laboratories was entirely rebuilt and greatly enlarged. The new building is 72 ft. x 100 ft., and is four storeys high with a basement under half of it. The top floor and part of the second are occupied by the assaying laboratories. The rest of the

building is given up to the ore dressing and mining laboratories, the commodious library and study rooms, lavatory and shower baths, rooms for the staff, two rooms for research in ore dressing, a model and map room and storerooms. The main ore dressing laboratory, 72 ft. x 53 ft. x 22 ft. high, is equipped with the old five stamp battery with amalgamation plates, Wilfley table, Deister Plato table, Deister slime table, an old-fashioned buddle and classifiers. Parallel with the stamp mill is a ball mill 30 in. x 24 in., which can be used alternatively with the stamps in connection with the concentrating tables. At one side of this main laboratory is apparatus representing the complete flow-sheet of a modern concentrator designed for continuous operation at the rate of 50 to 100 lbs. per hour. This plant consists of feeders, two rod mills and a ball mill each 18 in. x 12 in., with classifiers, two Wilfley tables, a Dorr type thickener, a six-cell Fahrenwald Sub A flotation unit, a conditioner, a small pilot Wilfley table, and a Genter thickener. Another laboratory, 70 ft. x 25 ft., is set aside for batch work and contains a variety of flotation machines, small ball and rod mills, apparatus for cyanide tests and for tests in magnetic concentration. Other rooms are set apart for hand screening, microscopes, balances, a chemical room and a room for roasting and other high temperature testing of ores in connection with ore dressing.

The crushing laboratory contains a Hatfield gyratory crusher, a set of rolls 16 in. x 12 in., a small Dodge crusher, two sets of miniature rolls, two disc grinders, and a dry screening machine of the Feraris type. Adjoining this room is a large room for practising sampling methods. The mining laboratory is equipped with an Ingersoll-Rand type E.R.-1 compressor and a variety of air drills representing the development of this machine, blocks of synthetic ore for practising sampling, forges for sharpening steel and moils, and shortly to be completed a laboratory for the study of ventilation problems, air conditioning, dust counts, etc. In the main basement are bins for the accommodation of a large variety of ores from the different mining districts.

MUSEUM

The ROYAL ONTARIO MUSEUM, with exhibits in Archaeology, Geology, Mineralogy, Palaeontology and Zoology, is situated at the southwest corner of Bloor Street and Queen's Park.

Students of the University in all departments are recommended to avail themselves of the privileges of the Museum, which, although under separate control, is intimately connected with the work of the University.

The Museum is open on all week days from 10 a.m. to 5 p.m., and on Sundays from 2 p.m. to 5 p.m. The admission is free to the public on Tuesday, Thursday, Saturday and Sunday. On other days an admission fee of fifteen cents is charged.

By a resolution of the Board of Trustees all regular students of the University may be admitted free on all days of the week by presenting their card of registration.

ONTARIO BOARD OF HEALTH LABORATORY

Through the courtesy of the Secretary of the Provincial Board of Health for Ontario the facilities of the excellently equipped laboratory which the Board maintains at Stanley Park have, with certain conditions, been placed at the service of the University for the investigation of problems of interest to the sanitarian and the sanitary engineer. The equipment consists of various types of sewage sedimentation tank, sewage filter, sewage measuring devices, aerators, sterilizing appliances and a complete and representative plant intended for the filtration and sterilization of water by practically all known methods.

PHOTOGRAPHIC AND PROJECTION LABORATORIES

The Photographic Laboratory contains a supply of small cameras for the use of students, enlarging cameras, printers, blue printing machine and the necessary dark rooms.

This Department also carries on a photographic and projection service for all Faculties and Departments of the University. The equipment for this work consists of cameras for making photographs up to full plate size, enlargers, photo-micrographic apparatus, motion picture cameras for both gross and micro work, with the necessary developing and printing machines, a rotary blue print machine, a photostat, etc.

For projection service there is a motion picture projector and a number of projection lanterns for service in any University Building.

THERMODYNAMICS AND MECHANICAL LABORATORY

This laboratory is included in a large, well-equipped building for the accommodation of the steam, gas, mechanical and hydraulic equipment. A more complete description of the laboratories has been published elsewhere, so that the present description is only intended to give the main features.

The part of the building set apart for thermodynamics and other mechanical work is the ground floor of a room 60 ft. x 155 ft. This room is lighted entirely from the roof in a very perfect way. A part of the space 40 ft. wide running the entire length of 155 feet is served by a 3 ton travelling crane and contains the following equipment:

50 h.p. Brown engine with separate jackets on both heads and barrel of cylinder.

Two-stage Rand air compressor having compound steam cylinders, each fitted with Meyer cut-off gear. The low pressure air cylinder has Corliss inlet gear.

30 h.p. high-speed Leonard tandem compound engine with shaft governor.

15 h.p. high-speed McEwen engine.

40 h.p. Uniflow engine.

25 h.p. General Electric steam turbine.

Two 15 h.p. Leonard engines with different types of valves, which are used for valve setting.

Centrifugal air compressor.

There are also two surface condensers with air pumps so arranged that any engine in the laboratory may be made to exhaust into the atmosphere through an open heater or into one of the condensers, the change from one arrangement to the other being accomplished in a few minutes without the aid of valves.

The laboratory further contains:

A 3 ton York refrigerating machine with tanks.

An Amsler transmission dynamometer.

Apparatus for testing injectors and steam pumps.

Hot blast heating equipment.

Numerous other pieces of apparatus and instruments.

The work on internal combustion engines and producers is performed on the following:

14 h.p. National gas engine arranged for various compressions and points of ignition.

25 h.p. horizontal Diesel engine made by Ruston and Hornsby, specially arranged for testing.

25 h.p. Allen semi-Diesel engine.

25 h.p. tractor gasoline engine.

Six cylinder Chevrolet automobile engine.

200 h.p. Sprague electric dynamometer.

Various accessories to above machines.

Steam for the laboratory is supplied by two 50 h.p. and one 100 h.p. Babcock and Wilcox boilers, the latter having an internal superheater. These boilers are located in a separate boiler room. They are used for experimental work only and are fitted up for testing. The gases pass up through two independent chimneys, and these have been arranged so that the draft and other conditions in the chimney at any point of its height may be examined.

In smaller work-rooms off the main laboratory are placed belt and oil-testing machines, apparatus for testing the efficiency of gears and machines, and for experiments in the balancing of machinery.

SECTION XIII. DISCIPLINE

1. (a) There is vested in the Council of each federated University or college, and of each faculty, disciplinary jurisdiction over and entire responsibility for the conduct of their students in respect of all matters arising or occurring in or upon their respective buildings and grounds, including residences.

(b) Disciplinary jurisdiction in all other cases as respects all students is vested in the Caput.

(c) The Students' Administrative Council, in the discharge of all duties entrusted to it, will be suported in the due discharge of those duties by the disciplinary power of the Caput.

2. No student will be allowed to continue in attendance, whose presence is deemed by the Council of his college or faculty to be prejudicial to the interests of the University.

3. Students proceeding regularly to the degree are required to attend the courses of instruction and the examinations in all subjects prescribed for students of their respective standing, and no student will be permitted to remain in the University who persistently neglects academic work.

4. Unless special permission is granted by the Council of the Faculty concerned, a student will not be permitted further registration in the University if, at the end of two sessions spent in the same year of the Faculty in which he is registered, he has failed to obtain the standing necessary to qualify him for registration in the succeeding year of the Faculty. An appeal from the decision of the Faculty Council may be made to the Senate.

5. All interference on the part of any student with the personal liberty of another by arresting him, or summoning him to appear before any tribunal of students, or otherwise subjecting him to any indignity or personal violence, is forbidden by the Caput and by the Councils of the colleges and faculties.

6. No initiation ceremony involving personal violence, personal indignity, interference with personal liberty, or destruction of property, may be held by the students of any college or faculty of the University, under the penalty of suspension or expulsion.

7. Any reception of the students of the first year in any college or faculty must be approved by the Council of that college or faculty, but such reception must not involve any infraction of the regulations of the two preceding paragraphs.

8. The organizing of a parade in the streets of the city, or the taking part in such parade without the permission of the authorities of the city on application of the Students' Administrative Council, will be regarded as a breach of discipline.

9. A student who is under suspension, or who has been expelled from a college or faculty or from the University, will not be admitted to the University buildings or grounds.

10. The constitution of every society or association of students in the Faculty of Applied Science and Engineering, and all amendments to any such constitution, must be submitted to and approved by the Council of the Faculty. All programmes of such societies or associations, must before publication, receive the sanction of the Council. Permission to invite any person not a member of a faculty of the University to preside at or address a meeting of any such society or association must be similarly obtained.

11. The name of the University is not to be used in connection with a publication of any kind without the permission of the Caput.

12. Students of any faculty or college on the premises of colleges or faculties other than those in which they are registered shall be subject to the regulations and penalties imposed by the administrative authorities of the premises concerned.

SECTION XIV. HART HOUSE

Hart House, the gift of the Massey Foundation, is so called in memory of Mr. Hart Massey. This House, which is for the use of men only, is far more than a students' club. In its widest interpretation it seeks to provide for all the activities in the undergraduate's life apart from the actual work in the lecture room.

Hart House contains under one roof a dining hall, common-rooms, library, debates room, music room, a small chapel together with rooms for the use of the Student Christian Movement, an art gallery, an arts and crafts room, photographic rooms, billiard room, gymnasia, swimming pool, running track, rifle range, and theatre.

The House is open from 8.00 a.m. to 11.00 p.m. daily and meals are served to students in the Great Hall. Members are entitled to full privileges of all rooms in the building between these hours and the use of the gymnasia, pool, showers and locker rooms until 6.30 p.m. each day except Saturday and Sunday, subject to the regulations of the Athletic Association. On Saturday the pool, together with the rest of the athletic wing, closes at 4.00 p.m.

The Warden is entrusted with the general supervision of the whole House, but the athletic wing is under the direct control of the Athletic Directorate. In great measure the care of the House and its welfare are entrusted to the students themselves. There are a number of committees, most of which consist of ten undergraduates, three senior members, and the Warden. The undergraduates on all these committees are elected annually by the undergraduate members of Hart House and the undergraduate secretaries of six of them (House, Hall, Library, Music, Art, and Debates) sit on the Board of Stewards which, together with certain appointed members, is the governing board of the House and directly responsible to the Board of Governors. Of this Board the Warden is ex-officio Chairman. The Comptroller, the Assistant Comptroller, the Secretary, and the Assistant Secretary of Hart House are responsible for the administration.

All men undergraduates proceeding to a degree in the University are member of Hart House. The annual fee of $10.00 covers all fees in connection with Hart House and membership in the Athletic Association for the academic year (September to May). To prevent the use of the building by unauthorised persons every member should carry his registration card and show it on request. Any member wishing to introduce a guest should obtain a card from the Warden's office.

Occasional students are not ordinarily eligible for membership in Hart House, but may make application to the Warden's office for election by the Membership Committee.

Graduate students, graduates resident in Toronto, and out of town graduates are entitled to the full privileges of Hart House when they have been duly elected and have paid the annual fee.

HART HOUSE THEATRE

Hart House Theatre is a Repertory Theatre existing to promote the interests of dramatic art in the widest sense. Its performances are open to members of the University and to the general public. The theatre is operated by a Board of Syndics, who are responsible to the Governors of the University for its administration. It is the policy of the Syndics to permit the rental of the theatre by those recognized dramatic societies within and outside the University which are endeavouring to do serious work.

THE SOLDIERS' TOWER

To commemorate the sacrifice of those graduates and undergraduates of our University who gave their lives in the Great War (1914-1918), the graduates have erected the Soldiers' Tower. Situated at the South-west corner of Hart House, the Tower rises—a symbol of sacrifice—and with its screen forms a majestic link between Hart House and the old Main Building. Beneath the sheltering arches of the screen, the names of the six hundred and eighteen, to whom the memorial pays its proud and affectionate tribute, are cut deep in the stone. Above, in the belfry of the Tower, is a carillon that, as it chimes, weaves a fabric of memories for professors and students who take up the tasks laid down by those who fell.

SECTION XV. STUDENT ORGANIZATIONS

THE JOINT EXECUTIVE, STUDENTS' ADMINISTRATIVE COUNCILS

The Joint Executive, Students' Administrative Councils, is composed of the President and Head of the recognized men and women student organizations in each of the colleges, faculties and departments of the University, as outlined in Article 4 of the Constitution. The Joint Executive assumes responsibility of the publication of The Varsity, Torontonensis and the Students' Hand Book. It represents the students at University functions and on public occasions; and receives and administers all funds accruing from Student Council fees, revenues from publications and such other funds as shall become the property of the Joint Executive; and through its secretaries it organizes such inter-collegiate and University activities as may be of interest to the student body as a whole.

The University band and the symphony orchestra are organized and administered by the Students' Administrative Council. The sale of students' athletic season tickets, official University rings, pins, crests, etc., and orders for official blazers are also in the hands of the Council. In addition, the Council operates an employment bureau for men and women undergraduates for summer, Christmas, and part-time work. It operates a loan fund for men and women undergraduates in the final two years of their courses. Applications for loans must be made to the Students' Administrative Council's office in January of each year.

The annual fee paid by all undergraduates proceeding to a degree, provides for a year's subscription to "The Varsity" and entitles the student to a copy of "Torontonensis" upon graduation, and also to a copy of "The Students' Hand Book" at the beginning of each Michaelmas term. The fee also covers administrative costs of the Joint Executive.

UNIVERSITY OF TORONTO ATHLETIC ASSOCIATION

University Athletics for men are under the entire control of the University of Toronto Athletic Association, of which the executive body is the Athletic Directorate. This consists of:

- the President of the University,
- two members of the faculty, appointed by the President,
- two graduates, appointed by the Athletic Advisory Board,
- the Medical Director, the Athletic Director and the Financial Secretary (*ex-officio*),
- five undergraduates, elected annually, from the student body,
- an undergraduate representative, appointed by the Men Students' Administrative Council.

· The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with men's athletics, and no men's athletic event can be held in the University without its approval. It has full control and direction of the gymnasium, the swimming pool, and other conveniences in connection with athletics in Hart House, the athletic fields and Stadium. The Directorate is empowered by the Board of Governors to make the necessary arrangements to effect the carrying out of the University regulations requiring Physical Training for men.

UNIVERSITY OF TORONTO WOMEN'S ATHLETIC ASSOCIATION

University athletics for women are under the entire control of the University of Toronto Women's Athletic Association, of which the executive body is the Women's Athletic Directorate. This consists of:

- the President of the University,
- two women members of the faculty, appointed by the President,
- two women graduates, elected by the Women's Athletic Advisory Board,
- the Medical Adviser for Women, the Physical Directress, and the Financial Secretary (*ex-officio*),
- five women undergraduates, elected annually.
- one woman undergraduate, appointed by the Joint Executive, Students' Administrative Councils.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with women's athletics, and no woman student may participate in any athletic event during the academic year without its permission. The Medical Adviser for Women and the Physical Directress are authorized to arrange for such Physical Training for women as is required by the University.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

The objects of the Engineering Society as set forth in its constitution are:

(*a*) The encouragement of original research in Engineering,

(*b*) The preservation of the results of such research,

(*c*) The dissemination of these results among its members,

(*d*) The cultivation of a spirit of mutual assistance and co-operation among the members of the Society in the preparation for, and in the practice of, the profession of Engineering,

(*e*) To afford an official means of communication between the Student body and the Faculty Council, the University authorities, and the students of other Faculties.

For purposes of organization the Engineering Society consists of a federation of clubs named as follows:

(*a*) The Civil Club of the Engineering Society, composed of undergraduates in Civil Engineering,

(*b*) The Mining and Metallurgical Club of the Engineering Society, composed of the undergraduates in Mining and Metallurgical Engineering,

(*c*) The Mechanical Club of the Engineering Society, composed of the undergraduates in Mechanical Engineering,

(*d*) The Electrical Club of the Engineering Society, composed of the undergraduates in Electrical Engineering,

(*e*) The Architectural Club of the Engineering Society, composed of the undergraduates in Architecture,

(*f*) The Industrial Chemical Club of the Engineering Society, composed of the undergraduates in Chemical Engineering,

(*g*) The Faculty of Applied Science Debating Club, composed of all undergraduates of the Faculty of Applied Science and Engineering.

These Clubs devote themselves to subjects of special interest to their members. Each club holds meetings at regular intervals, when papers are read, and discussions take place in technical subjects.

The Society meets during the academic years (except in April), beginning with the third Monday in October. Addresses are given by prominent men on subjects of general interest.

The Society publishes an annual, called "Transactions", which contains the addresses given at the meetings and an account of the year's activities.

A Supply Department is conducted by the Society on a co-operative plan, through which instruments, draughting supplies, stationery, and other supplies, can be purchased.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

Affiliated with the Engineering Society is the Faculty of Applied Science Athletic Association.

The Athletic Association has full control over all athletic clubs using the name of the Faculty of Applied Science. The Executive Committee has power to suspend anyone from the privileges of membership in the Association for any breach of its regulations, and controls the finances of all athletic clubs in the aforesaid Faculty. The annual membership fee of this Association is two dollars.

No other moneys are collected for the support of athletics in the Faculty of Applied Science without the sanction of the Executive Committee.

STUDENT CHRISTIAN MOVEMENT

The Student Christian Movement in the University of Toronto is part of an international fellowship of students in the colleges and universities of the world.

It is a fellowship, based on the conviction that in Jesus Christ are found the supreme revelation of God and the means to the full realization of life.

It seeks, through study, prayer, and practice, to understand and follow Jesus Christ and to unite in its fellowship all students who share its basic conviction as well as those who wish to test its truth.

Some of the means employed by the Movement in realizing its purpose are study groups, worship services, forum discussions, conferences, lectures and addresses by prominent religious leaders, and social service in the downtown district. It is not necessary to "join" in order to share in the programme of the Movement. Its activities are open to all.

Full information may be had from the S.C.M. executives in the various Colleges, or from the General Secretaries of the S.C.M.: Rev. W. C. Lockhart, Hart House, for the men; and Miss D. Fleming and Miss F. Peden, Household Science Building, for the women. The names of the executives will be found in the Student's Hand Book.

UNIVERSITY OF TORONTO C.O.T.C.

The Toronto Contingent of the Canadian Officers Training Corps was organized in 1914, and is a unit of the non-permanent Active Militia. Its primary object is to provide students at Universities with a standardized measure of military training with a view to their qualifying for commissions in the country's auxiliary forces. C.O.T.C. certificates of qualification exempt their holders from examination for commissioned rank on joining a militia unit in Canada, or, if resident in the British Islands, render them eligible for commissions in the Army Reserve of Officers, the Militia, or the Territorial Army.

The facilities which are offered by the contingent for obtaining a qualification while at the University are intended to enable young gentlemen to give personal service to their country with the least possible interference with their civil careers, to ensure that units have their establishments complete in the junior commissioned ranks, and to build up an adequate reserve of scientifically trained officers who have completed a period of consecutive and systematic military training, on academic lines, of a nature calculated to produce good officers.

The contingent provides the practical work for students taking the Military Studies option for the Arts degree, as also physical exercise for students who may choose this as the form in which they will take their compulsory Physical Training. In addition to service in the corps for a University credit, students of any year or faculty are trained in it to qualify for officers' certificates in the Infantry, Artillery, Engineers, Army Medical Corps and Signallers, writing on the examinations set by the War Office for members of O.T.C. contingents throughout the Empire.

Permanent commissions in the Royal Canadian Air Force and the Permanent Forces of the Canadian Militia are open to qualified cadets of the C.O.T.C.; selected cadets may also attend summer camps of instruction in Artillery, Signalling, Small Arms and Aviation.

There are at present four companies and the training of each is so arranged that, on leaving the University, students may be qualified for commissions in that branch of the militia to which their University course particularly applied.

The present Headquarters are at 184 College Street, and include armouries, members' reading room, library, and lecture rooms.

The Contingent Staff is:

Officer Commanding............Lieut.-Col. H. H. Madill, V.D., m.s.c.
Second in Command..............................Major W. S. Wilson
Adjutant....................................Capt. W. E. Carswell
Paymaster..Capt. T. A. Reed
Quartermaster..
Medical Officer..............................Capt. D. L. MacLean
Chaplain...
Contingent Sergeant-Major.....S-M. W. Hunt, late Royal Welch Fusiliers
Company Commanders:
"A" Co...................................Lieut. H. C. H. Miller
"B" Co.......................................Capt. H. G. Oborne
"C" Co. (Applied Science)..............Major M. B. Watson, m.s.c.
"D" Co ....Capt. F. R. Crocombe

SECTION XVI. LODGING AND BOARD

GENERAL

Accommodation is readily obtainable in numerous private boarding-houses within a short distance of the University, at a cost of from ten dollars a week upwards and board obtained separately at about seven dollars per week. A list of accredited boarding-houses is kept by the Secretary of the Students' Administrative Council in Hart House and students are recommended to consult him with reference to the selection of suitable accommodation.

RESIDENCE FOR MEN

Through the generosity of the late E. C. Whitney, Esq., Mrs. Whitney and friends, the University offers to approximately one hundred and fifty men the advantages of residential life within its own grounds. The Residence consists of three Houses: South, East and North.

The regular rates are $3.25 a week for a single room or half of a suite (two bedrooms and common study). For men holding matriculation or undergraduate scholarships, for first class honour men in the Faculty of Arts, and for honours men in the other Faculties, the rates are $3.00 a week. An occupant entitled to the lower rate must, when paying his rent, submit to the Bursar the evidence that he has the required standing. A student of the Faculty of Arts requiring this evidence may obtain it in the form of a certificate from the Registrar, Simcoe Hall; a student of any other Faculty may obtain it from the Secretary of his Faculty.

Except under very special circumstances occupants who withdraw at any time during the session will be required to pay the full rent up to April 1st.

Applications for rooms must be submitted to the Secretary of the Residence Committee, Registrar's Office. Forms for this purpose will be supplied on request. Each application must be accompanied by a deposit, of $5.00. This deposit will be returned if the applicant is not admitted, but will be forfeited by the applicant if notification, in writing, of his refusal to accept the room assigned is not received by the Secretary before September 15th. On request the deposit will be refunded in full at the end of the College year if the room key is returned and the room and furniture left in a satisfactory condition.

The University lays down three general rules designed to prevent hazing, gambling, and the use of intoxicants.

A circular giving further information may be obtained from the Secretary of the Residence Committee.

SUMMARY OF STUDENTS IN ATTENDANCE

SESSION 1935-36

Year	1	2	3	4	5	6	7	8	Total
I	19	47	32	5	12	88	35	12	248
II	8	37	27	7	7	63	13	13	175
III	8	21	26	7	..	56	36	6	160
IV	18	17	43	11	..	45	30	12	176
V	..	..	..	7	..	..	..	..	7
	53	122	128	37	19	252	114	43	768

For graduate students, see p. 166

APPENDIX. GRADUATE STUDIES

Graduates interested in pursuing courses for post-graduate degrees should send inquiries to the Secretary of the School of Graduate Studies.

AERONAUTICS

The University is equipped with a four-foot wind tunnel in a specially designed building; and, so far as the facilities permit, properly prepared graduates will be admitted for private study, or for a course leading to an advanced degree (M.A.Sc. or Ph.D.).

Graduates who wish to undertake this work should apply to the Head of the Department of Mechanical Engineering; and, if they are candidates for an advanced degree, should also register with the Secretary of the School of Graduate Studies, in accordance with the conditions laid down in the Calendar of that School.

REGULATIONS FOR DEGREES

MASTER OF APPLIED SCIENCE, MASTER OF ARCHITECTURE

The regulations governing the Degrees of Master of Applied Science (M.A.Sc.) and Master of Architecture (M.Arch.) shall be determined as follows:

1*a*. A candidate for the degree of Master of Applied Science shall hold the degree of Bachelor of Applied Science of this University or a degree from some other University recognized as equivalent by the Council of the School of Graduate Studies.

1*b*. A candidate for the degree of Master of Architecture shall hold the degree of Bachelor of Architecture or the degree of Bachelor of Applied Science in Architecture of this University or a degree from some other University recognized as equivalent by the Council of the School of Graduate Studies.

2. He shall register with the Secretary of the School of Graduate Studies at the beginning of the academic year.

3. Not later than November 1, he shall submit to the Secretary for acceptance by the Council of the School of Graduate Studies the title of his proposed thesis as approved by the department concerned.

4. Not later than May 15, he shall present evidence to the Council of the School of Graduate Studies that he has spent not less than one academic year in the department concerned as a student enrolled in one of the following departments on a course of study approved by the department: Civil Engineering, Mining Engineering, Mechanical Engineering, Architecture, Chemical Engineering, Electrical Engineering, Metallurgical Engineering.

5. Not later than May 15, evidence that the candidate has satisfactorily met all the requirements of the department with regard to thesis and to such examinations as the department shall require, shall be forwarded to the Council of the School of Graduate Studies through the sub-committee administering the regulations governing the degrees of Master of Applied Science and Master of Architecture.

CIVIL ENGINEER, MINING ENGINEER, MECHANICAL ENGINEER, ELECTRICAL ENGINEER, CHEMICAL ENGINEER, METALLURGICAL ENGINEER

The regulations governing the Professional Degrees of Civil Engineer (C.E.), Mining Engineer (M.E.), Mechanical Engineer (M.E.), Electrical Engineer (E.E.), Chemical Engineer (Chem.E.), Metallurgical Engineer (Met.E.), shall be determined as follows:

1. A candidate for one of the said degrees shall hold the diploma of the School of Practical Science or of the Faculty of Applied Science and Engineering or the degree of Bachelor of Applied Science, or shall have spent not less than two years as a member of the teaching staff in this Faculty after having graduated in Engineering from another institution of recognized reputation.

2. He shall have spent at least three years after receiving the diploma or the degree in the actual practice of the branch of engineering wherein he is a candidate for a degree.

3. Intervals of non-employment, or of employment in other branches of engineering, shall not be included in the above three years. It shall not be necessary that the several periods requisite to make up the said three years be consecutive.

4. The candidate shall obtain from the Secretary of the School of Graduate Studies, the formal application form, which, properly filled out, accompanied by the designated evidence of professional experience and by the title and synopsis of the proposed thesis, shall be delivered to the Secretary not later than the first day of November.

The evidence of professional experience shall fully describe the kind and extent of all work undertaken by the candidate since the date of graduation up to the time of application, indicating clearly the degree of responsibility for such work. Certificates from present and past employers shall accompany the application. The names and addresses of not less than five engineers to whom the candidate is personally known and who have knowledge of his professional activities shall be submitted.

5. The application, and the subject of the thesis is subject to the approval of the Board of Examiners, who may satisfy themselves by oral or written examinations in regard to the candidate's experience and competence in engineering works.

6. The candidate after notification of the approval of the Board shall prepare an original engineering thesis in the branch in which he has applied for a degree. This thesis shall be on work in which the candidate has had

actual experience and shall preferably be on the design of engineering works or processes, and shall be accompanied by all necessary descriptions, details, drawings, bills of materials, specifications, and estimates. A thesis of a solely descriptive type will not be acceptable.

7. The thesis, with accompanying papers, described in clause 6, shall be sent to the Secretary not later than the first day of March.

8. The candidate may be required to present himself for examination in the months of March or April at such time as may be arranged by the examiners.

9. The thesis, drawings, and other papers submitted under clause 7 shall become the property of the University.

10. Nothing in this statute shall prevent any candidate from receiving more than one of the said degrees, provided he has the necessary qualifications for each degree. An interval of three years must elapse between the granting of any two degrees under this statute.

DOCTOR OF PHILOSOPHY

Graduates of the Faculty of Applied Science and Engineering may proceed to the degree of Doctor of Philosophy. Information as to the conditions to be met by candidates for this degree is to be found in the Calendar of the School of Graduate Studies, which may be obtained from the Registrar of the University. The degree is an academic degree, not a professional one, and the research work and courses leading to the degree are primarily concerned with the fundamentals and underlying principles of the sciences. In general, a candidate selects one major and two minor subjects for study, the research being carried out in the major subject. A period of three years is usually required for the fulfilment of the requirements for the degree. However, it should be understood that the degree is not granted for the passing of prescribed courses or for the performance of prescribed laboratory work for a period of three years. The laboratory research work must have led to results of a high order, constituting a real contribution to the science of the major subject, and the candidate must have attained a decided maturity of knowledge and outlook before he may present himself for final examination by the Committee of the School of Graduate Studies. A graduate proposing to proceed to this degree should consult, in the first instance, with the members of the staff in the department in which he proposes to take his major subject.

A list of major and minor options in the Department of Chemical Engineering and in the Department of Mechanical Engineering are to be found in the Calendar of the School of Graduate Studies.

HIGH SCHOOL ASSISTANTS' CERTIFICATES

The Department of Education of Ontario has agreed to accept the degree of Bachelor of Applied Science as fulfilling the academic requirement for admission to the course for a High School Assistants' certificate in the Ontario College of Education.

SPECIALISTS' CERTIFICATES

By an agreement between the University of Toronto and the Department of Education of Ontario, persons holding the degree of Bachelor of Applied Science may, by taking certain prescribed courses in the Faculty of Arts, complete the academic requirements for admission to the qualifying examination for specialist courses in (*a*) Mathematics and Physics and (*b*) Science, at the Ontario College of Education. Information regarding these prescribed courses may be obtained from a pamphlet issued by the Registrar of the University, from whom copies may be had on application. Each person who desires to complete these academic requirements should communicate directly with the Registrar in order that his case may be considered and his particular conditions defined.

The Department of Education has approved of the acceptance of the degree in Applied Science in the Department of Engineering Physics, with standing of at least 60% at the final examination, as covering the academic requirements for admission to the qualifying examination for the Specialists' course in Mathematics and Physics at the Ontario College of Education.

ONTARIO LAND SURVEYORS AND DOMINION LAND SURVEYORS

Examinations are held usually in February of each year, for the following:

Preliminary Dominion Land Surveyors
Leveller's Examination
Final Dominion Land Surveyors
Ontario Land Surveyors

Any student in this faculty is eligible for these examinations, but graduates in Civil and Mining Engineering are allowed a shortened apprenticeship before writing their final examinations. Full information respecting above examinations may be obtained from the staff in Surveying and Geodesy.

GRADUATES ENROLLED IN THE DEPARTMENTS OF THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Civil Engineering, Municipal and Structural	4
Mining Engineering	3
Mechanical Engineering	2
Chemical Engineering	11
Total	20

INDEX

UNIVERSITY OF TORONTO

ANNUAL ATHLETIC FEE

Commencing with the session 1937-1938, by order of the Board of Governors an annual Athletic fee has been authorized as follows:—

The annual Athletic fee $3.00

Every student in attendance proceeding to a Bachelor's degree is required to pay to the Bursar on or before October 15th the annual Athletic fee of three dollars.

UNIVERSITY OF TORONTO

CALENDAR

FACULTY OF APPLIED SCIENCE
AND
ENGINEERING

1937-1938

THE UNIVERSITY OF TORONTO PRESS
1937

1937 CALENDAR 1937

JANUARY

Sun.		3	10	17	24	31
Mon.		4	11	18	25	..
Tues.		5	12	19	26	..
Wed.		6	13	20	27	..
Thur.		7	14	21	28	..
Fri.	1	8	15	22	29	..
Sat.	2	9	16	23	30	..

FEBRUARY

Sun.	.	7	14	21	28
Mon	1	8	15	22	..
Tues.	2	9	16	23	..
Wed.	3	10	17	24	..
Thur.	4	11	18	25	..
Fri.	5	12	19	26	..
Sat.	6	13	20	27	..

MARCH

Sun.	.	7	14	21	28
Mon	1	8	15	22	29
Tues.	2	9	16	23	30
Wed.	3	10	17	24	31
Thur.	4	11	18	25	..
Fri.	5	12	19	26	..
Sat.	6	13	20	27	..

APRIL

Sun.	.	4	11	18	25
Mon	.	5	12	19	26
Tues.	.	6	13	20	27
Wed.	.	7	14	21	28
Thur.	1	8	15	22	29
Fri.	2	9	16	23	30
Sat.	3	10	17	24	..

MAY

Sun.		2	9	16	23	30
Mon.		3	10	17	24	31
Tues.		4	11	18	25	..
Wed.		5	12	19	26	..
Thur.		6	13	20	27	..
Fri		7	14	21	28	..
Sat	1	8	15	22	29	..

JUNE

Sun.	.	6	13	20	27
Mon.	.	7	14	21	28
Tues.	1	8	15	22	29
Wed.	2	9	16	23	30
Thur.	3	10	17	24	..
Fri.	4	11	18	25	..
Sat.	5	12	19	26	..

JULY

Sun.	.	4	11	18	25
Mon.	.	5	12	19	26
Tues.	.	6	13	20	27
Wed.	.	7	14	21	28
Thur.	1	8	15	22	29
Fri.	2	9	16	23	30
Sat.	3	10	17	24	31

AUGUST

Sun.	1	8	15	22	29
Mon.	2	9	16	23	30
Tues.	3	10	17	24	31
Wed.	4	11	18	25	..
Thur.	5	12	19	26	..
Fri.	6	13	20	27	..
Sat.	7	14	21	28	..

SEPTEMBER

Sun.	.	5	12	19	26
Mon.	.	6	13	20	27
Tues.	.	7	14	21	28
Wed.	1	8	15	22	29
Thur.	2	9	16	23	30
Fri.	3	10	17	24	..
Sat.	4	11	18	25	..

OCTOBER

Sun.		3	10	17	24	31
Mon.		4	11	18	25	..
Tues.		5	12	19	26	..
Wed.		6	13	20	27	..
Thur.		7	14	21	28	..
Fri.	1	8	15	22	29	..
Sat.	2	9	16	23	30	..

NOVEMBER

Sun.	.	7	14	21	28
Mon.	1	8	15	22	29
Tues.	2	9	16	23	30
Wed.	3	10	17	24	..
Thur.	4	11	18	25	..
Fri.	5	12	19	26	..
Sat.	6	13	20	27	..

DECEMBER

Sun.	.	5	12	19	26
Mon	.	6	13	20	27
Tues.	.	7	14	21	28
Wed.	1	8	15	22	29
Thur.	2	9	16	23	30
Fri.	3	10	17	24	31
Sat.	4	11	18	25	..

1938 CALENDAR 1938

JANUARY

Sun.		2	9	16	23	30
Mon.		3	10	17	24	31
Tues.		4	11	18	25	..
Wed.		5	12	19	26	..
Thur.		6	13	20	27	..
Fri.	.	7	14	21	28	..
Sat.	1	8	15	22	29	..

FEBRUARY

Sun.	.	6	13	20	27
Mon.	.	7	14	21	28
Tues.	1	8	15	22	..
Wed.	2	9	16	23	..
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MARCH

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Mon.	.	7	14	21	28
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Wed.	2	9	16	23	30
Thur.	3	10	17	24	31
Fri.	4	11	18	25	..
Sat.	5	12	19	26	..

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Sun.		3	10	17	24
Mon.		4	11	18	25
Tues.		5	12	19	26
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Thur.		7	14	21	28
Fri.	1	8	15	22	29
Sat.	2	9	16	23	30

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Mon.	2	9	16	23	30
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Wed.	4	11	18	25	..
Thur.	5	12	19	26	..
Fri.	6	13	20	27	..
Sat.	7	14	21	28	..

JUNE

Sun.	.	5	12	19	26
Mon.	.	6	13	20	27
Tues	.	7	14	21	28
Wed.	1	8	15	22	29
Thur.	2	9	16	23	30
Fri.	3	10	17	24	..
Sat.	4	11	18	25	..

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Sun.		3	10	17	24	31
Mon.		4	11	18	25	..
Tues.		5	12	19	26	..
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Mon.	1	8	15	22	29
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Sun.	.	4	11	18	25
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Sat.	5	12	19	26	..

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Thur.	1	8	15	22	29
Fri.	2	9	16	23	30
Sat.	3	10	17	24	31

CONTENTS

SECTION I. CALENDAR 1937-1938

MICHAELMAS TERM 1937

July 1 Thur....Dominion Day. Buildings closed.
July 15 Thur....Last day for receiving applications for Supplemental Examinations.
Aug. 14 Sat.....Students of the III year, Depts. 1, 2 and 9, report at University Survey Camp.
Sept. 4 Sat.....Students of the IV year, Dept. 1, Astronomy Option, report at University Survey Camp.
Sept. 6 Mon....Labour Day. Buildings closed.
Sept. 14 Tues....Supplemental Examinations commence.
Sept. 23 Thur....Special meeting of Faculty Council.
Sept. 27 Mon....Registration in person of the I year from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building. Students in Architecture of the II, III, and IV years report at University Survey Camp.
Sept. 28 Tues....Registration in person of the II and III years (except Architecture) from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.
The Dean's address to the I year at 9.00 a.m. in Room 38, Engineering Building.
Preliminary instruction and classification tests for the I year in Room 38, Engineering Building.
Meeting of Faculty Council.
Sept. 29 Wed....Lectures and Laboratory work commence for I, II, and III years at 9.00 a.m.
Registration in person of the IV year (except Architecture), and the V year in Architecture, from 9.00 a.m. to 1.00 p.m. Work for these students commences at 2.00 p.m.
The opening address by the President to the students of all faculties at 4.00 p.m. in Convocation Hall.
Oct. 1 Fri.....Meeting of Faculty Council.
Oct. 2 Sat.....Stated meeting of the Caput to deal with requests as to social functions until November 15.
Oct. 6 Wed....Registration in person of II, III, and IV years in Architecture at the Faculty Office.
Oct. 8 Fri.....Meeting of Senate.
Oct. 12 Tues....Meeting of Engineering Society.
Oct. 25 Mon....Meeting of Engineering Society.
Nov. 1 Mon....Meeting of Faculty Council.
Nov. 10 Wed....Meeting of Engineering Society.

Nov. 11 Thur....Remembrance Day. Service at the Soldiers' Tower at 11.00 a.m. Neither lectures nor laboratory classes given from 10.40 a.m. to 11.20 a.m.
Nov. 12 Fri.....Meeting of Senate.
Nov. 25 Thur....Meeting of Engineering Society.
Dec. 1 Wed....Meeting of Faculty Council.
Dec. 10 Fri.....Meeting of Senate.
Meeting of Engineering Society.
Dec. 18 Sat.....Michaelmas term ends at 12.00 noon.
Dec. 25 Sat.....Christmas Day. Buildings closed.

EASTER TERM 1938

Jan. 1 Sat......New Year's Day. Buildings closed.
Jan. 3 Mon....Easter Term begins.
Mid-session Examinations commence.
Meeting of Faculty Council.
Jan. 10 Mon....Meeting of Engineering Society.
Jan. 14 Fri.....Meeting of Senate.
Jan. 25 Tues....Meeting of Engineering Society.
Feb. 1 Tues....Meeting of Faculty Council.
Feb. 9 We.d...Meeting of Engineering Society.
Feb. 11 Fri.....Meeting of Senate.
Feb. 24 Thurs...Meeting of Engineering Saciety.
Mar. 1 Tues....Meeting of Faculty Council.
Mar. 2 Wed....Meeting of Engineering Society. (Nominations.)
Mar. 4 Fri.....Engineering Society Annual Elections.
Mar. 11 Fri.....Meeting of Senate.
Mar. 14 Mon....Engineering Society Annual General Meeting.
Apr. 1 Fri.....Meeting of Faculty Council.
Apr. 5 Tues....Easter Term ends at 5.00 p.m.
Apr. 8 Fri.....Meeting of Senate.
Apr. 11 Mon....Annual Examinations commence.
Apr. 15-16 Fri.-Sat...Easter. Buildings closed.
May 2 Mon....Meeting of Faculty Council.
May 13 Fri.....Meeting of Senate.
May 24 Tues....Victoria Day. Buildings closed.
June 8 Wed....Meeting of Senate.
June 9-10 Thur.-Fri..University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

1936-1937

THE UNIVERSITY

President. . THE HON. AND REV. H. J. CODY, M.A., D.D., LL.D., F.R.S.C.
Registrar. . . . . A. B. FENNELL, M.C., M.A.
Bursar. . . . . F. A. MOURÉ, MUS. DOC.
Librarian. . . . . W. S. WALLACE, M.A., F.R.S.C.
Superintendent of Buildings and Grounds. . . . . A. D. LEPAN, B.A.SC.
Director of University Extension and Publicity. . W. J. DUNLOP, B.A., B.PAED.
Warden of Hart House. . . . . J. B. BICKERSTETH, M.C., M.A.
Director of University Health Service. . . . . G. D. PORTER, M.B.
Medical Adviser for Women Students. . MISS E. GORDON, B.A., M.B., D.P.H.
Manager of the University of Toronto Press. . . . .

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean. . . . . . . C. H. MITCHELL, C.B., C.M.G., D.S.O., C.E., LL.D., D.Eng.
Secretary. . . . . W. S. WILSON, B.A.SC., M.E.I.C.

INQUIRIES

Inquiries about admission to the Faculty of Applied Science and Engineering should be sent to the Registrar of the University.

Communications relating to curriculum, instruction and examinations, in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information about opportunities for graduates of this Faculty, reference may be made to a pamphlet issued by the Director of University Extension and Publicity entitled "Opportunities for Graduates of Applied Science and Engineering."

SECTION III. TEACHING STAFF

1936-1937

PROFESSORS

E. A. Allcut, M.Sc. (B'ham.), M.E. (Tor.), M.I.Mech.E. 48 Foxbar Rd.
Professor of Mechanical Engineering.

G. R. Anderson, M.A., A.M. (Har.), M.I.E.S., F.A.S.A. 7 Rose Park Cr.
Professor Emeritus of Engineering Physics and Photography.

R. W. Angus, B.A.Sc., M.E., M.E.I.C., M.A.S.M.E. Mechanical Bldg.
Professor of Mechanical Engineering.

E. G. R. Ardagh, B.A.Sc., F.C.I.C., F.R.S.C. 80 Strathallan Blvd.
Professor of Applied Chemistry.

E. R. Arthur, M.A., B.Arch. (Liverpool), A.R.I.B.A. 163 Walmer Rd.
Professor of Architectural Design.

J. W. Bain, B.A.Sc., F.I.C., F.R.S.C. 393 Brunswick Ave.
Professor of Chemical Engineering.

E. W. Banting, B.A.Sc. 101 Farnham Ave.
Associate Professor of Civil Engineering: Surveying and Geodesy.

B. de F. Bayly, B.A.Sc. 227 Roehampton Ave.
Assistant Professor of Electrical Engineering.

M. C. Boswell, B.A.Sc., M.A. (Har.), Ph.D., F.R.S.C. Mining Bldg.
Professor of Organic Chemistry (in Chemical Engineering).

H. J. Burden, D.S.O., D.F.C., B.A.Sc., M.F.A. (Princ.)
Assistant Professor of Architecture. 26 Old Forest Hill Rd.

J. R. Cockburn, M.C., V.D., B.A.Sc., M.E.I.C. 100 Walmer Rd.
Professor of Descriptive Geometry.

S. R. Crerar, B.A.Sc., D.L.S. 122 Grenadier Rd.
Associate Professor of Surveying.

W. B. Dunbar, B.A.Sc., A.M.E.I.C. 241 Glebeholme Blvd.
Assistant Professor of Engineering Drawing.

F. C. Dyer, B.A.Sc., M.E.I.C. 164 Colin Ave.
Associate Professor of Mining Engineering.

G. A. Guess, M.A. (Qu.) Oakville, Ont.
Professor of Metallurgical Engineering.

H. E. T. Haultain, C.E., M.E.I.C. 156 Glencairn Ave.
Professor of Mining Engineering.

K. B. Jackson, B.A.Sc. 362 Glengrove Ave. W.
Assistant Professor of Applied Physics.

J. T. King, B.A.Sc. 126 Manor Rd. E.
Associate Professor of Mining Engineering.

A. T. Laing, B.A.Sc. 146 Balmoral Ave.
Associate Professor of Highway Engineering (retired).

T. R. LOUDON, B.A.Sc., M.E.I.C. 189 Sheldrake Blvd.
Professor of Applied Mechanics.

W. G. McINTOSH, B.A.Sc. 105 Bedford Rd.
Assistant Professor of Mechanical Enginering.

R. R. McLAUGHLIN, M.A.Sc., M.A., Ph.D. 52 Rosedale Rd.
Assistant Professor of Chemical Engineering.

H. H. MADILL, V.D., B.A.Sc., F.R.A.I.C. 47 Eastbourne Ave.
Professor of Architecture.

J. W. MELSON, B.A.Sc. 69 Walmsley Blvd.
Associate Professor of Civil Engineering: Surveying and Geodesy.

R. J. MONTGOMERY, B.Sc., Cer.E. (Ohio) 7 Cottingham Rd.
Associate Professor of Ceramics.

J. A. NEWCOMBE, B.Sc. (London), A.R.S.M. 10 Bowmore Rd.
Associate Professor of Metallurgical Engineering.

H. W. PRICE, B.A.Sc. 40 Ava Rd.
Professor of Electrical Engineering.

T. R. ROSEBRUGH, M.A., D.Sc., F.R.S.C. 92 Walmer Rd.
Professor Emeritus of Electrical Engineering.

E. A. SMITH, M.A. (McM.) Mining Bldg.
Assistant Professor of Chemical Engineering.

V. G. SMITH, B.A.Sc. 49 Nealon Ave.
Assistant Professor of Electrical Engineering.

W. J. SMITHER B.A.Sc., M.E.I.C. 35 Wilberton Rd
Associate Professor of Structural Engineering.

R. TAYLOR, B.A.Sc. 82 Glen Echo Rd.
Associate Professor of Mechanical Engineering.

J. E. TOOMER, B.Sc. (N. Carolina) 26 Edgar Ave.
Assistant Professor of Metallurgy.

W. M. TREADGOLD, B.A. 13 Woodlawn Ave. E.
Professor of Civil Engineering: Surveying and Geodesy.

A. WARDELL, B.A.Sc. 124 Melrose Ave
Assistant Professor of Engineering Drawing.

C. H. C. WRIGHT, B.A.Sc., M.R.A.I.C. 419 Markham St.
Professor Emeritus of Architecture.

W. J. T. WRIGHT, M.B.E., B.A.Sc. 126 Melrose Ave.
Associate Professor of Engineering Drawing.

C. R. YOUNG, B.A.Sc., C.E., M.E.I.C. 119 Glenayr Rd.
Professor of Civil Engineering: Municipal and Structural.

A. R. ZIMMER, B.A. Sc. 80 Pine Crest Rd.
Associate Professor of Electrical Engineering.

LECTURERS

A. E. BERRY, M.A.Sc., C.E., Ph.D. 235 Gainsborough Rd.
Special Lecturer in Municipal Engineering.

R. J. BROWN, B.A.Sc. 272 Beresford Ave.
Lecturer in Electrical Engineering.

W. E. CARSWELL, B.Arch. Apt. 231, 215 College St.
Lecturer in Architecture.

T. L. CROSSLEY., A.M.E.I.C. 28 Lonsdale Rd.
Special Lecturer in Pulp and Paper.

H. B. DUNINGTON-GRUBB 4 St. Thomas St.
Special Lecturer in Landscape Architecture.

T. C. GRAHAM, B.A.Sc. 12 Leith Pl.
Lecturer in Mechanical Engineering.

R. R. GRANT, O.L.S., C.A. 58 Poplar Plains Rd.
Special Lecturer in Accountancy and Business.

G. H. HALLY, B.A.Sc. Aurora
Lecturer in Mechanical Engineering.

P. V. JERMYN, B.A.Sc., M.E.I.C. 109 Cluny Dr.
Lecturer in Engineering Drawing.

F. H. KIRKPATRICK, Ph.B. (Hiram) 157 Alexandra Blvd.
Special Lecturer in Public Speaking.

R. E. LAIDLAW, B.A.Sc, K.C. 11 Dewbourne Ave.
Special Lecturer in Engineering Law.

M. J. C. LAZIER, B.A.Sc. 184 Briar Hill Ave.
Lecturer in Applied Mechanics.

G. R. LORD, B.A.Sc., S.M. (M.I.T.) 40 Maxwell Ave.
Lecturer in Mechanical Engineering.

A. S. MATHERS, B.A.Sc., A.R.C.A. 110 Highbourne Rd.
Special Lecturer in Architecture.

C. F. MORRISON, B.E. (Sask.), M.Sc. (McG.) A.M.E.I.C. 29 Claxton Blvd.
Lecturer in Civil Engineering: Municipal and Structural.

W. L. SAGAR, B.A.Sc., A.M.E.I.C. 38 Melrose Ave.
Lecturer in Civil Engineering: Municipal and Structural.

J. J. SPENCE, A.M.E.I.C. 162 Glencairn Ave.
Lecturer in Engineering Drawing.

R. C. WIREN, B.A.Sc., A.M.E.I.C., M.A.S.M.E. East House, U. of T.
Lecturer in Mechanical Engineering.

INSTRUCTORS

H. BOESCHENSTEIN, Ph.D. (Rostock) 103 Bedford Rd.
Instructor in Technical German.

C. A. BOOTH, B.A.Sc. 173 St. Germain Ave.
Instructor in Applied Physics.

R. M. CLARK, B.A.Sc. — 44 Willcocks St.
Instructor in Engineering Drawing.

F. COATES, A.R.C.A. — Scarborough Bluffs
Instructor in Modelling.

G. R. EDWARDS, B.A.Sc. — 1263 King St. W.
Instructor in Engineering Drawing.

A. M. FITZGERALD, B.A.Sc. — 150 Summit Dr.
Instructor in Chemical Engineering.

V. L. HENDERSON, B.A.Sc., A.M. (Mich.) — 18 Boswell Ave.
Instructor in Applied Physics.

C. W. JEFFERYS, R.C.A., O.S.A., LL.D.(Qu.) — 4111 Yonge St., York Mills, Ont.
Instructor in Painting.

MISS J. C. LAING, B.A. — 8 Williamson Rd.
Librarian, and Instructor in Architectural History and French.

J. E. REID, B.A.Sc. — 124 Bloor St. W.
Instructor in Electrical Engineering.

T. L. ROWE — 104 Braemore Gardens
Instructor in Civil Engineering: Surveying and Geodesy.

MACKENZIE WATERS, M.C., B.A.Sc. — 267 Roxborough St. E.
Special Instructor in Architectural Design.

S. E. WOLFE, M.A.Sc. — Streetsville
Instructor in Mining Engineering.

DEMONSTRATORS

BEAL, G. P., M.A.Sc. — 68 Lakeview Ave.
Senior Demonstrator in Chemical Engineering.

BELL, J. W., B.A.Sc. — 20 Hurndale Ave.
Demonstrator in Electrical Engineering.

BOWMAN, W. H., M.A.Sc., Sc.M. (N.Y.) — Apt. 324, 219 College St.
Demonstrator in Chemical Engineering.

BRECKENRIDGE, J. G., B.A.Sc., Ph.D. (Camb.) — 21 Cluny Ave.
Senior Demonstrator in Chemical Engineering.

CAMPBELL, C. G., B.A.Sc. — 76 Binscarth Rd.
Demonstrator in Thermodynamics.

CARSWELL, J. M., M.M., B.A.Sc. — 111 Spruce Hill Rd.
Demonstrator in Engineering Drawing.

EATON, G. T., M.A. McM., B.Sc. (Ac.) — Apt. 206, 262 Jarvis St.
Demonstrator in Chemical Engineering.

EWENS, F. G., B.A.Sc. — Apt. 3, 83 Madison Ave.
Demonstrator in Thermodynamics.

GALLAGHER, E. G., B.A.Sc. — 16 Cedar Ave.
Demonstrator in Hydraulics.

GALLOWAY, S. H., B.A.Sc. — 828 Shaw St.
Demonstrator in Electrical Engineering.

GAUVREAU, L. F., B.A.Sc.	492 Huron St.
Demonstrator in Mining Engineering.	
HAMLY, D. H., M.A., Ph.D.	106 Keewatin Ave.
Demonstrator in Applied Physics.	
HELWIG, C. E., B.A.Sc.	3 Vermont St.
Demonstrator in Civil Engineering: Municipal and Structural.	
HOPPER, S. A. J., B.A.Sc.	527 Shaw St.
Demonstrator in Mining Engineering.	
HOULE, A. U., B.A.Sc.	150 Hope St.
Demonstrator in Electrical Engineering.	
JACKSON, W. J., M.A.Sc.	13 Glen Morris St.
Demonstrator in Applied Physics.	
JANSEN, G. V., M.A.Sc.	107 Avenue Rd.
Demonstrator in Chemical Engineering.	
JONES, L. E., B.Sc., C.E. (Man.), M.A.Sc.	East House, Knox Coll.
Demonstrator in Applied Physics.	
KURTZ, J. V., B.A.Sc.	177 Rosewell Ave.
Demonstrator in Hydraulics.	
LAWSON, S. C. D., B.A.Sc.	Eglinton Ave. E., Leaside
Demonstrator in Machine Design.	
MACDONALD, W. C., M.A.Sc.	184 Glen Rd.
Senior Demonstrator in Chemical Engineering.	
MACROBIE, E. B., B.A.Sc.	Apt. 130, 121 Carlton St.
Demonstrator in Thermodynamics.	
MILLER, C. A., B.A.Sc,	9 Kingsmount Dr.
Demonstrator in Thermodynamics.	
MORRISON, W. B., B.A.Sc.	931 College St.
Demonstrator in Electrical Engineering.	
NORRIS, C. A., B.A.Sc.	407 Huron St.
Demonstrator in Electrical Engineering.	
RAPSON, W. H., M.A.Sc.	6 Edgewood Gdns.
Demonstrator in Chemical Engineering.	
RICKER, E. A., B.A.Sc.	53 Harbord St.
Demonstrator in Electrical Engineering.	
SANTO, R. E., B.A.Sc.	113 St. George St.
Demonstrator in Electrical Engineering.	
SIRMAN, W. R., B.A.Sc.	44 Peplar Ave.
Demonstrator in Hydraulics.	
TAYLOR, F. T., B.A.Sc.	318 Huron St.
Demonstrator in Engineering Drawing.	
TIDMAN, E. V., B.A.Sc.	92 Oakwood Ave.
Demonstrator in Civil Engineering: Surveying and Geodesy.	
WATSON, M. B., B.A.Sc., C.E., M.E.	121 Welland Ave.
Demonstrator in Engineering Drawing.	

PROFESSORS OF OTHER FACULTIES GIVING INSTRUCTION TO STUDENTS IN APPLIED SCIENCE

F. C. AULD, B.A. (McG.), M.A., B.C.L. (Ox.) — 21 Poplar Plains Cres.
Special Lecturer in Commercial Law.

S. BEATTY, M.A., Ph.D., F.R.S.C. — 537 Markham St.
Professor of Mathematics.

J. D. BURK, B.A. — 30 Duggan Ave.
Assistant Professor of Mathematics.

J. T. BURT-GERRANS, Phm. B., M.A., Ph.D. — 46 Dewson St.
Associate Professor of Electrochemistry.

E. F. BURTON, B.A. (Tor.), (Camb.), Ph.D., F.R.S.C.
Professor of Physics. — 224 Queens Drive, Weston

J. B. FERGUSON, B.A., F.R.S.C. — 100 Albertus Ave.
Associate Professor of Chemistry.

L. GILCHRIST, M.A., Ph.D. (Chic.), F.R.S.C. — North House, U. of T.
Professor of Physics.

F. B. KENRICK, M.A., Ph.D. (Leip.), F.R.S.C. — 77 Lonsdale Rd.
Professor of Chemistry.

A. MACLEAN, B.A. — 488 Spadina Ave.
Professor of Geology.

W. L. MILLER, C.B.E., B.A., Ph.D. (Munich), F.R.S.C.
Professor of Physical Chemistry. — 8 Hawthorne Ave.

E. S. MOORE, M.A., Ph.D. (Chic.), F.R.S.C. — 18 Indian Grove
Professor of Economic Geology.

A. L. PARSONS, A.B. (N.Y.) — 15 Glencairn Ave.
Professor of Mineralogy.

I. R. POUNDER, M.A., Ph.D. (Chic.) — 19 Glen Gordon Rd.
Professor of Mathematics.

D. A. F. ROBINSON, M.A., Ph.D. (Chic.) — 592 University Ave.
Assistant Professor of Mathematics.

L. J. ROGERS, B.A.Sc., M.A. — 110 Garfield Ave.
Associate Professor of Chemistry.

J. SATTERLY, M.A. (Camb.), D.Sc. (Lond.), F.R.S.C. — 95 Bernard Ave.
Professor of Physics.

SYNGE, J. L., M.A., Sc.D. (Dub.), E.R.S.C., — 222 Rose Park Dr.
Professor of Applied Mathematics.

J. E. THOMSON, B.A.Sc., Ph.D. (Har.), F.R.S.C. — 123 Welland Ave.
Professor of Mineralogy.

T. L. WALKER, M.A. (Qu.), Ph.D. (Leip.), F.R.S.C. — 20 Avondale Ave.
Professor of Mineralogy and Petrography.

SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate by statute, subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909-1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910-1911. In the session 1923-1924 the Degree of B.Arch. was offered to students in Architecture.

SECTION V. ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

GENERAL

1. Candidates for admission to the Faculty of Applied Science and Engineering must submit evidence to show that they are qualified to take one of the courses of instruction and proceed to a degree. Applicants must also submit a certificate of good character, and must have completed the seventeenth year of their age. The procedure for application and registration is described in paragraph 8 below.

2. In general, the holding of any of the following classes of certificate will constitute qualification for admission to this Faculty.

(*a*) Certificates of Ontario Pass and Honour Matriculation as described in paragraph 3 below.

(*b*) Certificates of having passed certain equivalent examinations as described in paragraph 5 below.

(*c*) Certificates of undergraduate work in other universities. See admission ad eundem statum, paragraphs 6 and 7 below.

The Senate will consider applications for the recognition of certificates other than those mentioned as occasion may require. Such certificates must be accompanied by an official statement of the marks in the various subjects upon which the certificate was granted.

ONTARIO MATRICULATION

3. Certificates of Ontario Matriculation for admission to the Faculty of Applied Science and Engineering must cover complete Pass Matriculation, and five subjects of Honour Matriculation.

PASS MATRICULATION

Complete Pass Matriculation will consist of these subjects:

English (Literature and Composition)
History (Canadian and Ancient), or Canadian History and Music,
Mathematics (Algebra and Geometry),
And three of: Greek (Authors and Accidence),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition), or
Spanish (Authors and Composition),
Science (Physics or Agriculture Part I, and Chemistry or Agriculture Part II),
Arithmetic with Mechanical Drawing* and Shop Work.*

*Credit in Mechanical Drawing and Shop Work will consist of certificates from the Principal of the School, accompanied by an approving certificate from the Director of the Technical School Branch of the Department of Education for Ontario. This option applies to students—and to such students only—who have been in attendance at, and matriculate from, a Technical School in the Province of Ontario and are so certified by the Department of Education of the Province

HONOUR MATRICULATION

Honour Matriculation will consist of these subjects:

English (Literature and Composition),
Algebra and Geometry,†
Trigonometry,†
Science (Physics and Chemistry),
And one of Greek (Authors and Composition),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition),
Spanish (Authors and Composition).

†Admission to the Department of Engineering Physics will be granted only to those who have met the regular requirements for admission to the Faculty of Applied Science and Engineering and, in addition, have obtained an average of 75 per cent. in the Mathematics (Algebra, Geometry, and Trigonometry) of the Honour Matriculation Examination. Students whose general proficiency record in other subjects is not correspondingly high are advised not to seek admission to the course.

4. Those intending to enter the course in Architecture are recommended to select French as one of the Matriculation subjects; those intending to enter Chemical, Civil, or Mechanical Engineering or Engineering Physics are recommended to select German; while those intending to enter Metallurgical Engineering are advised to select Spanish.

EQUIVALENT EXAMINATIONS

5. Certificates of the following examinations recognized as equivalent in value to the Ontario Matriculation, Pass, or Honour may be accepted as far as they meet the Ontario requirements in subjects and percentages. A candidate applying for admission on such certificates must submit an official statement of the marks upon which these certificates were awarded.

Province of Ontario

Middle School or Upper School examinations or examinations of the same standard under other names.

Province of Quebec

Quebec High School Leaving and Senior High School Leaving Examination Certificates.

Province of New Brunswick

Grammar School or First Class Licenses; also the Superior, except for Latin.

Province of Nova Scotia

High School Certificates of Grade XI and Grade XII issued by the Department of Education.

Province of Manitoba

Grade XI and Grade XII examinations.

Province of British Columbia

Junior (Grade XII) and Senior (Grade XIII) Matriculation examinations.

Province of Prince Edward Island

First Class License Certificates issued either by the Education Department or Prince of Wales College; Third Year Certificates issued by the above College.

Province of Alberta

Grade XI and Grade XII examinations.

Province of Saskatchewan

Grade XI and Grade XII examinations.

Newfoundland and the Maritime Provinces

Certificate of the Common Examining Board, Junior and Senior Associate Diplomas of the Department of Education of Newfoundland.

Great Britain

Certificate of having passed, or having exemption from, the Preliminary Examination of the Institution of Civil Engineers in the British Isles, or equivalent.

ADMISSION AD EUNDEM STATUM

6. An undergraduate of another university may be admitted ad eundem statum on such conditions as the Senate, on the recommendation of the Council of the Faculty, may prescribe.

7. An applicant for admission ad eundem statum must submit with his application for admission: (1) an official transcript of his record in the University from which he wishes to transfer, showing in detail the courses which he has completed with his standing in each; (2) certificate of honourable dismissal; (3) certificate of vaccination; and (4) calendar of the university giving a full description of these courses.

PROCEDURE FOR APPLICATION AND REGISTRATION

8. Candidates for admission should apply to the Registrar of the University for forms of applications for admission; they are required to fill in these forms in duplicate and return them to the Registrar *not later than* September 10th, together with the following: (*a*) all Pass and Honour

Matriculation or equivalent certificates which they may hold; (*b*) any other evidence of ability to take the work proposed; (*c*) certificate of good character; (*d*) certificate of vaccination. Failure to make early application will result in delay and inconvenience for the candidate.

9. By order of the Board of Governors, all candidates for admission must submit a certificate of successful vaccination with their application, or agree to submit such certificate within ten days after the opening of the session. The Directors of the University Health Services will arrange for the vaccination of those who so desire.

10. Every student must register in person with the Secretary of the Faculty as prescribed on page 5 of the Calendar.

11. A student who fails to register as prescribed in clause 10, must petition the Council for permission to register late. The Council, however, reserves the right to refuse the permission, or to impose a penalty, such penalty to be reckoned at one dollar per day, or part thereof, that elapses betweeen the close of registration as prescribed and the filing of the petition.

12. A petition for permission to register late must be accompanied by a deposit equal to the estimated amount of the penalty. Should the Council decide that no penalty is to be imposed, the deposit will be refunded.

SECTION VI. FEES AND DEPOSITS

1. Every student in attendance proceeding to a Bachelor's Degree in the Faculty of Applied Science and Engineering is required to pay the following annual fees: Composite, Medical Examination and Physical Training, Hart House (women exempt), Students' Administrative Councils, Engineering Society, and Athletic Association (women exempt). These fees are described in detail below.

All fees due in the Michaelmas term, with the exception of the Hart House fee, must be paid in full on or before October 15th, and all fees due in the Easter term on or before January 15th; after these dates a deferred payment fee of one dollar a month will be imposed in each term until the whole amount is paid.

2. Special fees are required for matriculation, supplemental examinations, admission ad eundem statum, and degrees.

3. (a) *Students must have paid fees due in the first term before proceeding to the work of the second term. A student will not be admitted to any of the University lectures or laboratory classes who is in arrears for his fees.*

(b) *A student will not be allowed to write any examination if he has not paid all fees for which he is liable at that time.*

COMPOSITE

4. (*a*) The composite fee, payable to the Bursar of the University, including tuition, library, laboratory supplies (but not laboratory deposits), and one annual examination for each year, shall be as follows:

If paid in full on or before October 15th $225.00

If paid in instalments:—

First instalment, if paid on or before October 15th 113.00

Second instalment, if paid on or before January 15th 115.00

(*b*) A student who is repeating his year is required to pay the same fee as other students.

SUPPLEMENTAL EXAMINATION

5. Candidates for supplemental examinations are required to pay a fee to the Bursar not later than September 1st. The fee for written examinations is $10.00 and for each supplemental examination in a laboratory subject requiring special supervision the fee is $20.00.

MATRICULATION, OR REGISTRATION OF MATRICULATION

6. Applicants for admission under paragraph 2, (*b*), (*c*), section V, are required to pay to the Bursar a fee of $5.00 for registration of matriculation.

ADMISSION AD EUNDEM STATUM

7. Applicants who are admitted ad eundem statum are required to pay to the Bursar a fee of $10.00.

DEGREES

8. Candidates for the degree of B.A.Sc., or B. Arch., are required to pay to the Bursar by January 15th of their year of graduation, a fee of $10.00.

MEDICAL EXAMINATION AND PHYSICAL TRAINING

9. Every man is required at the opening of each session in which Physical Training is compulsory for such student, to pay to the Bursar the annual fee of $5.00 for medical examination and such subsequent physical training as may be prescribed.

10. Every woman is required to pay a corresponding fee of $4.00.

HART HOUSE

11. Every man in attendance is required to pay to the Bursar on or before November 15th the annual fee of $12.00 for the maintenance of Hart House. If this fee is not paid by the above date a deferred payment fee of $2.00 will be imposed, making the total fee $14.00.

STUDENTS' ADMINISTRATIVE COUNCILS

12. Every student is required to pay to the Bursar at the time of registration the annual fee, as shown in the summary below, paragraph 16, for the maintenace of the Students' Administrative Councils.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

13. All students in attendance are required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Engineering Society.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

14. Each man in attendance is required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Athletic Association of the Faculty.

LABORATORY DEPOSIT

15. A laboratory breakage deposit, to be paid to the Faculty at the time of registration, is required from all students. The amount of the deposit is shown in the summary below. This deposit, less charges for waste, neglect, and breakages, will be refunded by the Secretary at the end of the session. Should the deposit be insufficient to meet the charges, a levy will be made to cover the deficiency.

16. SUMMARY OF FEES AND DEPOSITS

Composite in advance	$225.00 B
In instalments	228.00 B
Supplemental Examinations*	
Written	10.00 B
Laboratory	20.00 B
Matriculation, or registration of Matriculation	5.00 B
Degrees (B.A.Sc., B.Arch)	10.00 B
Medical Examination and Physical Training* (men)	5.00 B
Medical Examination and Physical Training* (women)	4.00 B
Hart House (women exempt)	12.00 B
Students' Administrative Councils,	
All Years except Graduating Year	2.00 B
Graduating Year	6.00 B
Engineering Society	2.00 F
Athletic Association (women exempt)	2.00 F
Laboratory Deposit, Civil, Mechanical, and Electrical Engineering, Architecture, and Engineering Physics	3.00 F
Mining, Chemical, and Metallurgical Engineering, and Mining Geology	8.00 F

Items marked "B" are payable at the office of the Bursar; items marked "F" are payable at the Faculty Office at the time of registration.

All cheques must be made payable to "University of Toronto."

*17. Every student who has neglected to complete satisfactorily the course in Physical Training of the First or Second Year, and who must take this work during a later year, will be required to pay to the Bursar at the opening of that session a supplemental fee of $10.00 in addition to the prescribed Medical Examination fee.

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating department, or school in which he intends to proceed to a degree. There are eight departments in Engineering and the School of Architecture from which the selection may be made; viz.,

Civil Engineering (Dept. 1),
Mining Engineering (Dept. 2),
Mechanical Engineering (Dept. 3),
Architecture (Dept. 4),
Engineering Physics (Dept. 5),
Chemical Engineering and Applied Chemistry (Dept. 6),
Electrical Engineering (Dept. 7),
Metallurgical Engineering (Dept. 8-8a).
Mining Geology (Dept. 9).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the courses in Engineering; and Bachelor of Architecture, to those who complete the course in Architecture.

3. The courses in Engineering extend over four academic years; the course in Architecture extends over five. A student must pass in the work of each academic year before proceeding to the work of the next. See p. 132, para. 3.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 20th, 1937.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction in Engineering and Architecture are given in Sec. IX, p. 24.

7. Examinations are conducted as explained in Sec. X, p. 132.

8. Students in Mining and Mechanical Engineering, Architecture, Electrical Engineering, and Mining Geology are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. See Sec. IX, p. 29, 33, 36, 59, 108 and 121.

9. Graduates in Engineering and Architecture may proceed to post graduate and professional degrees. The post graduate degrees include M. Arch., M.A.Sc., Ph.D.; and the professional degrees, C.E., Chem. E., E.E., M.E. (Mechanical Engineer), M.E. (Mining Engineer), and Met. E.

The courses for these degrees are under the direction of the School of Graduate Studies, and candidates should send their inquiries to the Secretary of the School of Graduate Studies. Some of the requirements of these courses are given in an appendix to this Calendar.

SECTION VIII. SCHOOL OF ENGINEERING RESEARCH

THE SCHOOL

A School of Engineering Research, within the Faculty of Applied Science and Engineering, was established in the Spring of 1917 at the suggestion of the late Dean Ellis.

The School is under the direct supervision of a Committee of Management composed of fifteen members of the Faculty Council. To this Committee of the Council is entrusted the selection of researches to be undertaken under the auspices of the School, and the disposition of funds for conducting them.

The School was organized chiefly for the training of graduates in methods of research, and for the carrying out of investigations. These latter may be problems relating to specific industries or raw materials and having a specific end in view, or general problems having to do with fundamental principles.

RESEARCH ASSISTANTS

A number of research assistants in the School of Engineering Research are appointed annually on salary in the various departments of the Faculty to carry on the work of research under direction of members of the staff. This work is accepted as partial fulfilment of the requirements for the degrees of M.A.Sc., M.Arch. and Ph.D. These research assistants are usually recent graduates, and are chosen from among those who have displayed special capacity for investigation in their undergraduate courses. Applicants should consult with members of the staff as soon as possible after the April examinations.

The facilities of the School are also open to graduates who desire to penetrate more deeply into particular phases of experimental work, or to undertake investigations either suggested by members of the staff or arising from their own work since graduation.

INQUIRIES

All communications should be sent to the secretary, Professor M. C. Boswell, Ph.D.

SECTION IX. CURRICULUM

The courses of instruction are designed to give the student a thorough grounding in the fundamentals of engineering or architecture; and, in addition, sufficient familiarity with the practical application of the principles to make him useful upon graduation. The courses are very similar in the First Year with the exception of those of Architecture, Engineering Physics and Chemical Engineering. In the succeeding years specialization develops to some extent with provision in the Third and Fourth years for optional courses in some of the graduating departments.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As the future engineer is vitally concerned with the development of the country, it is essential that he be instructed in the rudiments of economics, administration, and business, which, with his scientific training, will enable him to increase his usefulness to the full.

In some graduating departments, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful training in methods of research. In this way the undergraduate course is linked with the graduate courses, and with the work of the School of Engineering Research (page 23).

As part of the laboratory instruction, excursions to places of technical interest, both in Toronto and elsewhere, are arranged by the staff. These excursions are treated as laboratory periods with the same requirements as to attendance and reports. The total transportation costs in any one year will probably not exceed ten dollars.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The program and regulations regarding the courses of study and examinations, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course, to the conditions here laid down.

Communications relating to curricula, instruction and examinations, in the Faculty of Applied Science and Engineering, should be sent to the Secretary of the Faculty.

DEPARTMENT OF CIVIL ENGINEERING
(DEPT. 1)

The course in Civil Engineering has been so designed as to be broad and comprehensive, with a view to meeting not only the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire a technical training of such a basic character as to enable them to enter various other fields of technical employment. Concurrent with the instruction in engineering subjects, sufficient attention is given to economic, legal and administrative matters to make the graduate in this Department fitted to enter not only upon such work as Municipal Engineering, Sanitary Engineering, Highway Engineering, Railway Engineering, Geodetic Surveying, Structural Engineering and Hydraulic Engineering, but also upon administrative and executive work in both engineering and industrial undertakings.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 112.

FIRST YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus...............	236	2	–	2	–
Applied Physics.............	187	1	3	1	3
Business....................	121	–	–	1	–
Descriptive Geometry.......	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Problems and Drawing................	166a	–	10	–	17
General Chemistry..........	84	2	–	1	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus..................	237	2	–	2	–
Chemical Laboratory........	89	–	–	–	6
Descriptive Geometry........	162	1	–	1	–
Economics and Finance......	123	1	–	1	–
Electricity..................	143, 144a	1	–	1	3
Elementary Astronomy......	71	1	–	1	–
Engineering Problems and Drawing................	167a	–	5	–	10
Engineering Chemistry.......	93	1	–	–	–
Geology...................	195	–	–	2	–
Inorganic Chemistry.........	87a	1	–	–	–
Least Squares...............	240	–	–	1	–
Mechanics of Materials......	4	2	–	2	–
Mineralogy................	257, 259	2	1	–	2
Organic Chemistry..........	95	–	–	1	–
Physical Metallurgy.........	252	–	–	1	–
Physical Training...........	280	–	2	–	2
Public Speaking.............	133	–	–	1	–
Spherical Trigonometry......	239	1	–	–	–
Surveying.................	272, 273	1	9	1	–

THIRD YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Elasticity...........	10a	1	–	1	–
Astronomy and Geodesy.....	72, 73	2	2	2	–
Cements and Concrete.......	11	1	–	1	–
Descriptive Geometry........	164	1	–	–	–
Engineering Chemistry.......	102	1	–	1	–
Engineering Problems and Drawing................	168a	–	13	–	14
Engineering Geology.........	197	1	–	1	–
Hydraulics.................	205, 206	2	–	2	3

THIRD YEAR SUBJECTS DEPT. 1—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Machinery	229	1	–	1	3
Mechanics of Materials Lab.	9	–	5	–	–
Stress Graphics	10	1	–	1	–
Survey Camp	275	–	–	–	–
Surveying	274	1	–	1	–
Theory of Structures	6	2	–	2	–
Thermodynamics	223, 224	1	–	1	2

FOURTH YEAR SUBJECTS DEPT. 1 (a) GENERAL OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Contracts and Specifications	127	–	–	1	–
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	1	–
Foundations	14	1	–	1	–
Hydraulics	211	1	3	1	–
Management	128	1	–	–	–
Mechanics of Materials Lab.	13	–	3	–	3
Miscellaneous Structures	19	–	–	1	–
Reinforced Concrete	15	1	–	1	–
Structural Design	17, 18	2	–	1	–
Theory of Structures	12	2	–	2	–
Thesis	285	–	3	–	–

And *one* of the following Elective Groups:

(1) Engineering Problems and Drawing	178a	–	15	–	15
(1) Highway Engineering	268	–	–	1	3
(1) Municipal Administration	131	–	–	1	–
(1) Sanitary Engineering	267, 267a	1	–	1	3
(1) Soil Mechanics	14a	1	–	–	–
(2) Engineering Problems and Drawing	178a	–	15	–	15
(2) Railway Engineering	269	1	–	2	4
(2) Railway Structures	269a	1	–	–	2
(2) Soil Mechanics	14a	1	–	–	–
(3) Engineering Problems and Drawing	178a	–	12	–	18
(3) Photographic Surveying	189	3	3	2	3

FOURTH YEAR SUBJECTS DEPT. 1 (b) ASTRONOMY OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Astronomy	74, 76	2	23	2	–
Contracts and Specifications	127	–	–	1	–
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Geodesy	75, 76	2	–	2	23
Management	128	1	–	–	–
Photographic Surveying	189a	1	2	1	2
Survey Camp	275	–	–	–	–
Thesis	285	–	3	–	–

DEPARTMENT OF MINING ENGINEERING
(DEPT. 2)

The course in Mining Engineering, which originated in 1878 as a course in Assaying and Mining Geology, is intended to serve as a preliminary training for those who expect to practise in some branch of Mining Engineering, such as exploration of mining areas and primary development, mine surveying, mining processes involving civil, mechanical and electric work of underground workings, mining machinery and operation; milling and treatment of ores, assaying and other forms of analysis and research, and administrative work in both engineering and industrial undertakings.

A candidate for the degree in the Department of Mining Engineering will be required to present satisfactory evidence of having had at least six months' practical experience in work connected with mining, metallurgy or geology, for which he must have received regular wages.

The time may be spent in geological survey, in ore dressing, smelter, or lixiviation works, in an assay office in the vicinity of mining or metallurgical works, in prospecting, or on any work in or about a mine other than as an office man, or clerk. Prospecting will only count one-half (*e.g.*, four months' prospecting will be counted as two months) and must not be submitted for more than three of the six months. Not more than three months on geological surveys or in assaying will be accepted as part of the six months.

It is important to note that this experience may be put in before the student is admitted to the University.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 112.

FIRST YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry. and....	238	1	–	2	–
Calculus................	236	2	–	2	–
Business....................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Engineering Problems and Drawing................	166b	–	9	–	12
General Chemistry..........	84	2	–	1	–
Mineralogy.................	255, 258	2	1	–	3
Mining Laboratory..........	50	–	–	–	3
Physical Training...........	280	–	2	–	2
Problems and Seminar.......		–	3	–	3
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	89, 90	–	6	–	6
Descriptive Geometry........	162	1	–	1	–
Dyn. and Struct. Geology....	198	1	–	–	–
Economics and Finance......	123	1	–	1	–
Electricity..................	143	1	–	1	–
Elementary Petrography.....	260	1	–	1	–
Engineering Problems and Drawing................	167b	–	3	–	10
Geology....................	195	–	–	2	–
Inorganic Chemistry.........	87a	1	–	–	–
Inorganic Chemistry.........	87b	–	–	1	–
Mechanics of Materials......	4	2	–	2	–

SECOND YEAR SUBJECTS DEPT. 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Metallurgy	241	–	–	1	–
Mineralogy	261	–	2	–	2
Mining	51, 53	1	3	–	–
Physical Training	280	–	2	–	2
Problems and Seminar		–	3	–	3
Steam Engines	216	1	–	–	–
Surveying	272a, 273	1	6	1	–
Theory of Measurements	65	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88, 99	1	6	1	3
Assaying	45, 46	1	3	–	3
Economic Geology	202, 203	1	–	3	2
Engineering Chemistry	102	1	–	1	–
Engineering Problems and Drawing	168b	–	6	–	3
Geological Field Work	193	–	–	–	–
Hydraulics	205, 206	2	–	2	3
Introductory Research	66	–	3	–	–
Metallurgy	243	1	–	1	–
Mining	54	1	–	1	–
Ore Dressing	58, 59	1	–	1	6
Petrography	262, 263	1	2	1	2
Physics of Ore Dressing	64	1	–	1	–
Problems and Seminar		–	3	–	3
Survey Camp	275	–	–	–	–
Theory of Structures	7	1	–	1	–
Vacation Work	69	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	47, 48	–	–	1	3
Electrical Laboratory	144a	–	3	–	–
Engineering Economics	125	–	–	1	–
Geology, Mining	200	–	–	2	–
Geology, Pleistocene and Physiographic	194, 201	1	1	1	–
Geology, Precambrian	199	2	–	–	–
Machine Design	234	1	–	1	3
Mechanics of Materials Lab.	9	–	–	–	3
Metallurgy	247	1	–	1	6
Mine Cost-Finding and Management	56	1	–	1	–
Mine Ventilation	57	2	3	–	–
Mining	55	1	–	1	–
Ore Dressing	60, 61	1	6	1	–
Problems and Seminar		–	3	–	3
Thermodynamics	223, 224	1	3	1	–
Thesis	67	–	7	–	9
Vacation Work	70	–	–	–	–

DEPARTMENT OF MECHANICAL ENGINEERING
(Dept. 3)

The mechanical engineer is concerned with the production and the use of power, and it is part of his work to design and manufacture suitable machinery for this purpose, and to instal and operate it. The Diesel engine and the steam turbine are the products of his effort, and he applies these prime movers to automobiles, aeroplanes, locomotives and other purposes. His work also includes the design of water turbines, and their use in hydro-electric systems.

Other branches of his work are the making of designs for air compressors, machine tools, pumps, refrigerating machines and their application to storage warehouses and ice-making, heating and ventilating equipment, materials-handling and conveying plants, and generally all mechanical work. General industrial and administrative problems are considered.

An effort is being made to help qualified students interested in the design of aeroplanes and high speed trains and cars, without laying undue stress on such work. Courses of lectures are provided and in the final year some laboratory work in the wind tunnel is available.

The following course of study has been devised to equip men for this service.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 112.

SHOP WORK

Every student registered in the Department of Mechanical Engineering is required to spend 1200 hours in mechanical work satisfactory to the Department. Half of this work must be done before the student commences his Third Year Annual Examinations in April, and the balance before he commences his Fourth Year Annual Examinations in April. The details in this regard are outlined in the Calendar under subjects 227a and 227b.

All or any part of this shop work may be completed before the student enters the University, and he is urged to complete all of it at as early a date in his course as possible.

Failure to meet the specified requirements within the time set will result in a failure in shop work, which will be dealt with similarly to a failure in any laboratory subject.

Certificate forms for this work may be obtained from the Secretary of the Faculty or from the Department.

FIRST YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or.....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Applied Physics.............	185a	1	3	1	3
Business....................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Problems and Drawing...............	166c	–	9	–	15
General Chemistry..........	84	2	–	1	–
Machines and Processes.......	228	1	–	1	–
Physical Training...........	280	–	2	–	2
Properties of Fluids..........	213	1	–	1	–
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	4	–	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus....................	237	2	–	2	–
Chemical Laboratory........	89	–	–	–	6
Descriptive Geometry........	162	1	–	1	–
Dynamics..................	3	1	–	1	–
Economics and Finance......	123	1	–	1	–
Electricity..................	136, 137	2	3	2	3
Engineering Chemistry.......	93	1	–	–	–
Engineering Problems and Drawing...............	167c	–	15	–	8
Hydrostatics...............	212	–	–	1	–
Inorganic Chemistry.........	87a	1	–	–	–
Machines and Processes......	228a	1	–	1	–
Mechanics of Materials......	4, 9	2	–	2	3
Metallurgy.................	241	–	–	1	–
Organic Chemistry..........	95	–	–	1	–
Physical Training...........	280	–	2	–	2
Properties of Fluids..........	214	1	–	1	–
Steam Engines..............	216	1	–	1	–
Theory of Mechanism........	230	2	–	2	–

THIRD YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Electrical Laboratory	140	–	4½	–	3
Engineering Chemistry	102	1	–	1	–
Engineering Problems and Drawing	168c	–	6	–	3
Heat Engines	218	2	–	2	–
Hydraulics	205, 206	2	–	2	3
Machine Design	233	2	9	2	8
Magnetism and Electricity	138	1	–	1	–
Mechanics of Machinery	231	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Shop Work	227a	–	–	–	–
Theory of Structures	7	1	–	1	–
Thermodynamics	217, 219	2	3	2	3

FOURTH YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Engineering Problems and Drawing	178c	–	3	–	–
Heat Treatment of Iron and Steel	253	1	–	1	–
Hydraulics	207, 208, 209	3	9	3	6
Industrial Management	130	1	–	1	–
Reinforced Concrete	20	1	–	–	–
Machine Design	235	2	6	2	9
Shop Work	227b	–	–	–	–
Structural Design	17, 18	2	–	–	–
Thermodynamics	220, 221, 222	3	6	3	9
Thesis	285	–	1	–	1

SHOP WORK

Attention is directed to the note on shop work on page 33.

SCHOOL OF ARCHITECTURE

(DEPT. 4)

The School of Architecture was established as a Department of the Faculty of Applied Science and Engineering in 1890 and is one of the oldest schools in the British Empire. The School is fortunate in enjoying a close connection with the Ontario Association of Architects and the Royal Architectural Institute of Canada, both of which organizations offer prizes and scholarships for competition in the School. Constant touch is kept between students and architects by lectures given fortnightly by prominent practitioners.

The School is one of a limited number in the Empire recognized by the Royal Institute of British Architects, which admits graduates to Associate Membership on application, without examination. The student is required to spend twelve months in the offices of recognized architects. This very important practical work is done in the long summer vacations and satisfactory evidence of its completion must be submitted before the granting of a degree. The Ontario Association of Architects, through its Registration Board, accepts the degree in Architecture coupled with the office practice requirement as qualification to practise the profession of Architecture in the Province of Ontario. As a matter of fact, however, few graduates commence practice without a continuation of their practical training. Travel in Europe is managed by most students, even with slender means, and their ability to sketch and photograph buildings does much to enrich their own cultural experience, and, indirectly, the architecture of the Province in which they will ultimately live. In the Fourth and Fifth Years, students may select either the Design Option or the Structural Option. In selecting the latter option, the student decides that his interests tend toward the engineering side of Architecture. Art subjects closely related to architecture, such as modelling, water colour drawing, etc., take their proper place in the course and are described in the following pages. An event in the academic year is the period spent at Gull Lake, a University Camp, where a week is spent under supervision and instruction sketching out of doors.

Broadly speaking, the course is arranged to lay a foundation for the subsequent life of the graduate. A very considerable portion of the course is devoted to architectural design, and a student graduating should have a thorough knowledge of the principles of this important subject. He should have formed a taste and developed an appreciation of the allied arts, which should make him a valuable member of any community.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 112.

FIRST YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Advanced Mathematics or	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus	236	2	–	2	–
Architectural Design	31	–	12	–	14
Building Construction	37	–	–	1	–
Descriptive Geometry	161	1	–	1	–
Elements of Arch. Form	28	1	–	1	–
Engineering Problems and Drawing	166d	–	4	–	4
Freehand Drawing	35	–	2	–	2
French	44	2	–	2	–
History of Architecture	25	1	–	1	–
Physical Training	280	–	2	–	2
Statics	1	2	–	2	–
Surveying	270a, 271a	1	3	–	–
Technical English	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Design	31a	–	15	–	15
Descriptive Geometry	163	1	–	1	–
Economics and Finance	123	1	–	1	–
English	122b	1	–	1	–
Freehand Drawing and Water Colour	35a	–	2	–	2
French	44a	2	–	2	–
History of Architecture	25a	1	–	1	–
Mechanics of Materials	5	2	–	2	–
Modelling	36	–	2	–	2
Photography	188	1	3	1	3
Physical Training	280	–	2	–	2
Theory of Arch. Planning	32	1	–	1	–
Vacation Work	41	–	–	–	–

THIRD YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Composition....	33	1	–	1	–
Architectural Design.........	31b	1	20	–	20
Commercial Law............	124	1	–	1	–
Freehand Drawing and Water Colour................	35b	–	2	–	2
French....................	44b	1	–	1	–
Functional Requirements of Buildings..............	26	1	–	1	–
Garden Design.............	27	1	–	–	–
History of Architecture......	25b	1	–	–	–
History of Architecture	25c	–	–	1	–
Light and Sound...........	190	1	2	1	2
Modelling.................	36a	–	2	–	2
Public Speaking............	133	1	–	–	–
Structural Design..........	8	1	3	1	3
Vacation Work.............	42	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Acoustics and Illumination Design.................	191	1	1	1	1
Building Materials..........	38	1	–	1	–
Building Stones.............	204	1	–	–	–
Ceramic Building Materials...	254j	–	–	1	–
Contracts and Specifications ..	127	–	–	1	–
Freehand Drawing from Life..	35c	–	2	–	2
Functional Requirements of Buildings..............	26	1	–	1	–
Garden Design.............	27a	1	–	–	–
History of Fine Art.........	30	1	–	1	–
Modelling.................	36b	–	2	–	2
Sanitary Science...........	39	1	–	1	–
Structural Design..........	16	1	3	1	3
Vacation Work.............	43	–	–	–	–
and either					
Architectural Design, *or*......	31c	1	21	1	21
Architectural Engineering....	31e	1	21	1	21

FIFTH YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Arch. Aspects of Town Planning	34	–	–	1	–
Architectural Economics	40a	1	–	1	–
Heating and Air Conditioning.	40	1	–	1	–
Professional Practice.........	39a	1	–	1	–
Structural Design...........	21	1	3	1	3
Water Colour and Life Drawing.....................	35d	2	–	2	–
and either					
Architectural Design, *or*......	31d	2	26	2	26
Architectural Engineering....	31f	2	28	2	28

DEPARTMENT OF ENGINEERING PHYSICS
(DEPT. 5)

Admission to this course is granted only to students who meet the special requirements set forth on page 16 of this Calendar.

The course is designed to afford a training in Mathematics and Physics beyond that which it is possible to give in the other undergraduate courses in engineering. It is believed that a wider and more thorough acquaintance with the basic sciences will bring to the student a readier appreciation of the nature of the technical problems with which he will later be confronted and a greater facility in the solution of them. A course of the kind offered should consequently be of particular value to those who desire to enter governmental or industrial research laboratories, or who wish to engage in any original work of investigation or development in the field of applied physics.

Throughout the four years of the course an effort is made to maintain the practical point of view in the theoretical instruction. This is effected, in part, by adopting wherever possible the engineering viewpoint in the teaching of mathematical and scientific subjects, and, in part, by the inclusion of certain basic engineering instruction.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Algebra and Calculus, 292, page 123.

FIRST YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Algebra and Calculus	292	3½	–	3½	–
Analytical Geometry	293	1½	–	1½	–
Descriptive Geometry	160	1	–	1	–
Electricity	135	2	–	2	–
Engineering Problems and Drawing	166e	–	3	–	6
Engineering Mechanics	5a	2	–	2	–
General Chemistry	85, 86	2	3	1	3
German	265a	2	–	2	–
Mineralogy	255, 258a	2	1	–	–
Physical Training	280	–	2	–	2
Properties of Matter, Mechanics and Heat	301	3	4½	3	4½

SECOND YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Geometry of Space	296	1	–	1	–
Descriptive Geometry........	162	1	–	1	–
Differential Calculus..........	294	2	–	2	–
Electricity..................	136, 137	2	3	2	–
Elementary Acoustics.........	304	1	–	–	–
Elementary Light............	303	1	–	1	–
Elementary Machine Design...	234a	1	3	1	3
Elementary Magnetism and Electricity..............	302	2	–	1	–
Engineering Chemistry.......	93	1	–	–	–
German....................	265b	1	–	1	–
Integral Calculus and Differential Equations...........	295	3	–	3	–
Magnetism, Electricity, Light, and Acoustics............	305	–	3	–	6
Mechanics of Materials.......	4, 9	2	–	2	3
Physical Chemistry...........	98	2	–	2	–
Physical Training............	280	–	2	–	2

Students in the Department of Engineering Physics are required to state at the beginning of the Third Year the options that they desire to pursue in the Third and Fourth Years. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give the work.

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Engineering Mechanics	5b	1	–	1	–
Differential Equations	297	1	–	1	–
Introduction to the Theory of Functions	298	1	–	1	–
Magnetism and Electricity	138	2	–	1	–
Mathematical Operations Applied to Physics	306	1	–	1	–
Physical Laboratory	311	–	3	–	3
Properties of Matter	309	2	–	2	–
Theoretical Mechanics	331	1	–	1	–

And *one* of the following options which must be continued in the Fourth Year.

Options 5c, Electricity and Communications					
Alternating Current	139	1	–	2	–
Electrical Design	141	1	–	1	–
Electrical Laboratory	140	–	6	–	6
Heat	310	1	–	1	–
Optics	312	1	3	1	3
Physical Metallurgy	244	–	–	2	–
Theory of Potential and Electrical Measurements	307	1	–	1	–
Thermionic Tubes	150	1	–	1	3
Option 5s, X-rays and Spectroscopy					
Alternating Current	139	1	–	2	–
Electrical Laboratory	140	–	6	–	6
Heat	310	1	–	1	–
Mineralogy	264	1	–	1	–
Optics	312	1	3	1	3
Organic Chemistry	110a	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Theory of Potential and Electrical Measurements	307	1	–	1	–
Thermionic Tubes	150	1	–	1	3

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5g, Geophysics					
Alternating Current..........	139	1	–	2	–
Electrical Laboratory.........	140	–	6	–	6
Heat.......................	310	1	–	1	–
Mineralogy..................	260	1	–	1	–
Optics......................	312	1	3	1	3
Organic Chemistry...........	110a	1	–	1	–
Physical Metallurgy..........	244	–	–	2	–
Theory of Potential and Electrical Measurements......	307	1	–	1	–
Thermionic Tubes............	150	1	–	1	3
Option 5h, Applied Hydromechanics					
Aircraft....................	341	1	–	1	–
Alternating Current..........	139	1	–	1	–
Electrical Laboratory.........	140	–	3	–	3
Engineering Problems and Drawing................	168eh	–	3	–	3
Heat.......................	310	1	–	1	–
Hydrodynamics..............	313	1	–	1	–
Optics......................	312	–	–	1	3
Physical Metallurgy..........	244	–	–	2	–
Theory of Structures.........	7	1	–	1	–
Thermodynamics.............	225	2	–	2	3
Option 5e, Elasticity of Materials and Structures					
Alternating Current..........	139	1	–	1	–
Electrical Laboratory.........	140	–	3	–	3
Engineering Problems and Drawing................	168ee	–	6	–	9
Optics......................	372	1	3	1	3
Physical Metallurgy..........	244	–	–	2	–
Stress Graphics..............	10	1	–	1	–
Theory of Structures.........	7	1	–	1	–
Option 5i, Illumination and Acoustics					
Alternating Current..........	139	1	–	2	–
Electrical Laboratory.........	140	–	6	–	6
Thermionic Tubes............	150	1	–	1	3

THIRD YEAR SUBJECTS, DEPT. 5—*Continued*

Heat	310	1	–	1	–
Optics	312	1	3	1	3
Theory of Potential and Electrical Measurements	307	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5c, Electricity and Communications					
Advanced Mathematical Operations used in Physics	314	1	–	1	–
Acoustics	149	1	–	–	–
Advanced Acoustics	316	1	–	–	–
Applied Electricity	145a, 145b	3	–	3	–
Conduction through Gases, Radioactivity, and Atomic Structure	315	1	–	1	–
Differential Equations of Mathematical Physics	332	2	–	2	–
Electrical Laboratory	146	–	6	–	6
Electromagnetic Theory	153	2	–	2	–
Engineering Economics	125	–	–	1	–
Operational Calculus	152	2	–	2	–
Physical Laboratory	317	–	3	–	3
Communication	147, 148	2	6	2	6
Thesis	285	–	–	–	–
Option 5s, X-Rays and Spectroscopy					
Acoustics	149	1	–	–	–
Advanced Acoustics	316	1	–	–	–
Advanced Mathematical Operations Used in Physics	314	1	–	1	–
Advanced Optics	318	1	–	1	–
Conduction through Gases, Radioactivity, and Atomic Structure	315	1	–	1	–
Differential Equations of Mathematical Physics	332	2	–	2	–
Electromagnetic Theory	153	2	–	2	–
Elementary Quantum Theory	320	–	–	1	–
Engineering Economics	125	–	–	1	–
Operational Calculus	152	2	–	2	–

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5s, X-Rays and Spectroscopy (continued)					
Physical Laboratory..........	317	–	9	–	9
Communication..............	147, 148	2	6	2	6
Series Spectra...............	319	–	–	1	–
Thesis.....................	285	–	–	–	–
X-Rays and Crystal Structure.	321	1	–	1	–
Option 5g, Geophysics					
Differential Equations of Mathematical Physics....	332	2	–	2	–
Dynamic and Structural Geology....................	198	1	–	–	–
Economic Geology...........	202, 203a	1	3	3	3
Electromagnetic Theory......	153	2	–	2	–
Elementary Geology..........	195	–	–	2	–
Geophysics..................	322	2	9	2	9
Location of Mineral Deposits..	203b	–	–	2	–
Mining Geology..............	200	–	–	2	–
Petrography.................	262, 263	1	2	1	2
Precambrian Geology.........	199	2	–	–	–
Wave Motion in Elastic Media.	323	1	–	1	–
Option 5h, Applied Hydromechanics					
Advanced Mathematical Operations Used in Physics.....	314	1	–	1	–
Aerodynamics...............	342	2	–	2	–
Aircraft Engines.............	343	1	–	1	–
Airplane Design and Stress Analysis................	344	2	9	2	9
Differential Equations of Mathematical Physics....	332	2	–	2	–
Dynamic Meteorology........	326	1	–	1	–
Hydrodynamic Laboratory....	345	–	6	–	6
Theoretical Hydrodynamics...	334	2	–	2	–
Thesis.....................	285	–	4	–	4

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5e, Elasticity of Materials and Structures					
Advanced Mathematical Operations Used in Physics.....	314	1	–	1	–
Advanced Structural Analysis .	12a	2	6	2	6
Applied Elasticity............	10b	–	–	1	–
Differential Equations of Mathematical Physics....	332	2	–	2	--
Engineering Mechanics Laboratory....................	13a	–	6	–	6
Operational Calculus.........	152	2	–	2	–
Theory of Elasticity..........	333	1	1	1	1
Theory of Structures.........	12	2	–	2	–
Thesis......................	285	–	–	–	–
Wave Motion in Elastic Media.	323	1	–	1	–
and *one* of the following:					
(*a*) Vibration of Structures	23, 23a	1	3	1	3
(*b*) Vibration of Machines	23, 23a	1	3	1	3
Option 5i, Illumination and Acoustics					
Advanced Acoustics..........	316	1	–	–	–
Advanced Mathematical Operations Used in Physics......	314	1	–	1	–
Applications of Thermionic Tubes..................	151	1	3	1	3
Architectural Acoustics.......	191a	2	6	2	6
Differential Equations of Mathematical Physics....	332	2	–	2	–
Operational Calculus.........	152	2	–	2	–
Photometry and Illumination Design.................	192b	2	6	2	6
Physical Laboratory..........	325	–	3	–	3
Physics of Light Production...	324	1	–	1	–

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(DEPT. 6)

The course is designed to give the student a thorough training in the underlying principles and laboratory methods of inorganic, organic, physical and analytical chemistry, in the applications of these to industrial chemistry and chemical engineering, and a general knowledge of the elements of thermodynamics, hydraulics, machine design, structural design, electricity, and metallurgy. A preliminary training of this nature with subsequent practical experience will enable him to undertake the design and construction and also the operation and management of the plant required in such branches of chemical industry as are concerned with the production of chemical and pharmaceutical products, petroleum and its products, rubber goods, leather and glue, soap, meat products, foodstuffs, vegetable and animal oils, sugar, pulp and paper, vegetable and animal fibres, artificial silk, coal tar and wood distillates, paints and varnishes, explosives, dyes, portland cement, metals and their alloys, electrochemical products, fermentation products, fertilizers, etc.

For those who by temperament and ability are attracted to chemical research there exist excellent opportunities in government, industrial, and medical research laboratories. Properly qualified students wishing to pursue experimental investigation as a life-work whether in industrial chemistry or in purely scientific chemistry may proceed in this department to the degrees M.A.Sc. and Ph.D., the laboratory research work of the Fourth Year serving as a connecting link between the undergraduate and graduate courses.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 112.

FIRST YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Biological Laboratory........	80	–	–	–	3
Business....................	121	–	–	1	–
Chemical Laboratory........	86	–	12	–	12
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Problems and Drawing................	166f	–	3	–	3
General Chemistry..........	85	2	–	1	–
German....................	265	2	–	2	–
Mineralogy Laboratory......	256	–	2	–	1
Optics.....................	185b	1	3	1	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus..................	237	2	–	2	–
Applied Physics Laboratory ..	186	–	–	–	1
Chemical Laboratory........	92, 97	–	10	–	8
Economics and Finance......	123	1	–	1	–
Electricity..................	136, 137	2	3	2	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Problems and Drawing................	167f	–	7	–	3
German....................	265	1	–	1	–
Hydrostatics................	212	–	–	1	–
Industrial Chemistry.........	94	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Industrial Chemistry	94a	–	–	–	5
Inorganic Chemistry	87a	1	–	–	–
Inorganic Chemistry	87b	–	–	1	–
Mechanics of Materials	4	2	–	2	–
Metallurgy	241	–	–	1	–
Organic Chemistry	96	2	–	2	–
Physical Chemistry	98	2	–	2	–
Physical Training	280	–	2	–	2

THIRD YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Analytical Chemistry	88	1	–	1	–
Assaying Laboratory	49	–	3	–	–
Chemical Laboratory	100, 104a, 106	–	13	–	13
Chemical Engineering	104	1	–	1	–
Electrical Laboratory	144b	–	–	–	3
Electrochemistry	107, 108	2	3	–	–
Engineering Chemistry	102	1	–	1	–
Engineering Problems and Drawing	168f	–	3	–	3
German	265	1	–	1	–
Hydraulics	205, 206	2	–	2	1½
Industrial Chemistry	103	1	–	1	–
Metallurgy	243	1	–	1	–
Organic Chemistry	105	2	–	2	–
Physical Metallurgy	244	–	–	2	–
Theory of Structures	7	1	–	1	–
Thermodynamics	217, 224	2	–	2	1½

FOURTH YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	111	–	17	–	–
Engineering Law............	126	1	–	–	–
German, *or*................	265	1	–	1	–
Spanish................	266	1	–	1	–
Industrial Management......	130	1	–	1	–
Inorganic Chemistry.........	109	2	–	2	–
Machine Design.............	234	1	–	1	3
Organic Chemistry..........	110	1	–	1	–
Thesis.....................	285	–	–	–	–
and *one* of					
1. Electrochemistry.........	114, 115	2	*	2	*
2. Industrial Chemistry.....	112, 113	1	*	1	*
3. Metallurgy and	247	1	*	1	*
Ore Dressing and	62, 63, 64	2	–	2	6
Physical Metallurgy.	250	1	*	1	*
4. Ceramics...............	254a	4	*	2	*
	254b	–	–	2	–
	254d	–	6	–	6
5. Zymology..............	283	*	*	*	*

*All time not otherwise allotted must be spent in the various laboratories in the proportions assigned by the Department.

For information regarding the courses of study leading to the degrees, Master of Applied Science and Doctor of Philosophy, see pp. 169 and 171 of this calendar, also the calendar of the School of Graduate Studies, which gives full particulars.

DEPARTMENT OF ELECTRICAL ENGINEERING
(DEPT. 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields beside that of his specialty, electrical technique. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but also thermodynamics, hydraulics, theory of mechanisms, machine design, business, economics and finance, commercial law, and other non-electrical subjects.

In the electrical field much time is given to calculation of circuits of electric, magnetic and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years. Certain options in this Year are available in combination with general electrical engineering; viz., hydraulics, thermodynamics, communication, electrochemistry and illumination.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial or administrative responsibilities.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 112.

FIRST YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Applied Physics............	185a	1	3	1	3
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Engineering Problems and Drawing...............	166g	–	12	–	18
General Chemistry..........	84	2	–	1	–
Physical Training...........	280	–	2	–	2
Practical Experience.........	276	–	–	–	–
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	4	–	–
Technical English..........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus...................	237	2	–	2	–
Chemical Laboratory........	89	–	6	–	–
Descriptive Geometry........	162	1	–	1	–
Dynamics..................	335	1	1	1	1
Economics and Finance......	123	1	–	1	–
Electricity.................	136, 137	2	3	2	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Problems and Drawing...............	167g	–	10	–	15
Hydrostatics...............	212	–	–	1	–
Inorganic Chemistry.........	87a	1	–	–	–
Mechanics of Materials.......	4	2	–	2	–
Organic Chemistry..........	95	–	–	1	–
Physical Training...........	280	–	2	–	2
Practical Experience.........	276	–	–	–	–
Steam Engines..............	216	1	–	1	–
Theory of Mechanism.......	230	2	–	2	–

THIRD YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	2	–
Commercial Law	124	1	–	1	–
Electrical Design	141	1	–	1	–
Electrical Design and Problems Laboratory	142	–	3	–	6
Electrical Laboratory	140	–	6	–	6
Electrochemistry	107, 108	2	3	–	–
Engineering Chemistry	102	1	–	1	–
Heat Engines	218	1	–	1	–
Hydraulics	205, 206	2	–	2	3
Machine Design	233	2	3	2	3
Magnetism and Electricity	138	2	–	1	–
Mechanics of Machinery	231	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Practical Experience	276	–	–	–	–
Thermodynamics	217, 219	2	3	2	–

FOURTH YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Electricity	145, 146	5	20	5	19
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Industrial Management	130	1	–	1	–
Practical Experience	276	–	–	–	–
Thesis	285	–	–	–	–
and *one* of					
1. Communication	147. 148, 149	3	9	2	9
2. Electrochemistry	114, 115	2	9	2	9
3. Hydraulics	207, 208, 209	3	9	3	6
4. Illumination	192, 192a	2	9	2	9
5. Thermodynamics	220, 221, 222	3	9	3	6

DEPARTMENT OF METALLURGICAL ENGINEERING
(DEPT. 8-8a)

Two separate courses of instruction are offered in this department. These are designated 8 and 8a. No. 8 deals with the treatment of ores and the metals from metallic minerals. No. 8a deals with the Ceramic and industrial non-metallic mineral field.

Course 8 is planned for those who intend to pursue Engineering work in connection with the milling or concentration of ores, the production of metals from ores or concentrates, the refining of metals or the manufacture and fabrication of steel and other alloys.

Course 8a offers a training for those who intend to work as Engineers in the ceramic and non-metallic mineral industries. Ceramics deals with the preparation of raw materials for and the manufacture of such products as refractories, cement, heavy clay products, porcelain, glass and enameled iron. Non-metallic mineral engineering includes the beneficiation and commercial utilization of such materials as asbestos, clay, diatomite, feldspar, gypsum, limestone, quartz and talc.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each; e.g., Analytical Geometry (238), page 112.

FIRST YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus................	236	2	–	2	–
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Engineering Problems and Drawing................	166h	–	13	–	19
General Chemistry..........	85	2	–	1	–
Mineralogy.................	255, 258a	2	1	–	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	4	–	–
Technical English...........	122a	1	–	1	–

Second Year Subjects Dept. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	87a, 87b, 91	1	14	1	13
Economics and Finance	123	1	–	1	–
Electricity	136, 137	2	3	2	3
Engineering Problems and Drawing	167h	–	3	–	6
Geology and Ore Deposits	196	1	1	1	1
Mechanics of Materials	4	2	–	2	–
Metallurgy	241, 242	1	–	2	–
Mining	51, 52	1	–	1	–
Physical Training	280	–	2	–	2
Steam Engines	216	1	–	–	–

Third Year Subjects Dept. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Analytical Chemistry	88	1	–	1	–
Assaying	45, 46	1	3	–	3
Cements and Concrete	11	1	–	–	–
Chemical Laboratory	101	–	–	–	6
Electrical Laboratory	144c	–	3	–	3
Electrochemistry	107, 108	2	3	–	–
Engineering Problems and Drawing	168h	–	3	–	–
Engineering Drawing	182	–	3	–	–
Engineering Chemistry	102	1	–	1	–
Heat Engines	218	1	–	1	–
Metallurgy	245	2	3	1	6
Ore Dressing	58, 59	1	3	1	3
Physical Metallurgy	246	1	3	1	–
Physics of Ore Dressing	64	1	–	1	–
Thermodynamics	223, 224	1	–	1	3

FOURTH YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	47, 48	–	–	1	3
Contracts and Specifications	127	–	–	1	–
Electrochemistry	114, 115	2	–	2	6
Engineering Economics	125	–	–	1	–
Hydraulic Laboratory	210	–	–	–	3
Machine Design	234	1	–	1	3
Metallurgy	249	1	–	1	–
Metallurgy Problems	248	2	4	2	4
Ore Dressing	60, 61	1	6	1	–
Physical Metallurgy	250	1	3	1	3
Plant Management	129	–	–	1	–
Thesis	285	–	6	–	6

Students who registered in the Faculty previous to the Session 1937-38 and who elect to take the Ceramics option as formerly prescribed may carry out the work of the Third Year as prescribed in the 1936-37 Calendar during the Sessions 1937-38 and 1938-39, and the work of the Fourth Year during the Sessions 1937-38, 1938-39 and 1939-40.

FIRST YEAR SUBJECTS DEPT. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus..............	236	2	–	2	–
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Elementary Mineralogy......	255, 258a	2	1	–	–
Engineering Problems and Drawing..............	166ha	–	3	–	3
General Chemistry..........	85	2	–	1	–
Inorganic Chemistry.........	86	–	9	–	15
Physical Training...........	280	–	2	–	2
Statics....................	1	2	–	2	–
Surveying.................	270, 271	1	4	–	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	92	–	10	–	8
Economics and Finance......	123	1	–	1	–
Elementary Machine Design..	232	1	–	1	–
Elementary Metallurgy......	241	–	–	1	–
Electricity.................	136, 137	2	3	2	3
Engineering Chemistry.......	93	1	–	–	–
Engineering Problems and Drawing..............	167ha	–	7	–	3
Geology and ore deposits.....	196	1	1	1	1
Hydrostatics................	212	–	–	1	–
Industrial Chemistry........	94	1	–	1	–
Industrial Chemistry........	94a	–	–	–	5
Inorganic Chemistry.........	87a	1	–	–	–
Inorganic Chemistry.........	87b	–	–	1	–
Mechanics of Materials......	4	2	–	2	–
Organic Chemistry...........	110a	1	–	1	–
Physical Chemistry..........	98	2	–	2	–
Physical Training...........	280	–	2	–	2

Third Year Subjects Dept. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88	1	–	1	–
Ceramics	254c	–	–	2	–
Chemical Engineering	104	1	–	1	–
Electrical Laboratory	144b	–	–	–	3
Electricity	139	1	–	1	–
Elementary Petrography	260	1	–	1	–
Engineering Chemistry	102	1	–	1	–
Engineering Problems and Drawing	168ha	–	3	–	3
Industrial Chemistry	100	–	13	–	3
Metallurgy	243	1	–	1	–
Non-metallic Minerals	254a	4	–	2	–
Non-metallic Mineral Laboratory	254b	–	6	–	9
Physical Metallurgy	244	–	–	2	–
Thermodynamics	217, 224	2	–	2	1½
Theory of Structures	7	1	–	1	–

Fourth Year Subjects Dept. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Ceramic Calculations	254d	1	–	–	–
Economic Geology	203c	–	–	2	–
General Petrography	262	1	–	1	–
General Petrography	263	–	2	–	2
Glass and Enamels	254g	1	–	1	–
Hydraulics	205, 206	2	–	2	1½
Industrial Management	130	1	–	1	–
Machine Design	234	1	–	1	3
Non-Metallic Mineral Laboratory	254e	–	6	–	3
Non-Metallic Mineral Laboratory	254i	–	6	–	6
Non-Metallic Mineral Products	254h	1	–	1	–
Ore-Dressing Laboratory	63	–	3	–	3
Physics of Ore-dressing	64	1	–	1	–
Plant Design	178ha	–	3	–	–
Refractories and Ceramic Bodies	254f	2	–	1	–
Silicate Chemistry	116a	2	–	–	–
Thesis	285	–	3	–	6

DEPARTMENT OF MINING GEOLOGY

(DEPT. 9)

The course in Mining Geology is designed to train more particularly those who wish to enter the field of applied geology but it is sufficiently broad to provide training for work in any branch of geology, unless it be in that in which an extensive knowledge of palaeontology is necessary.

The economic geologist is frequently brought into contact with engineering problems and it is essential that he receive a good grounding in those subjects, such as mathematics, mechanics, chemistry, physical sciences, surveying and engineering drawing, that constitute the preliminary work in engineering courses. It is necessary that he understand something of the language and methods of the mining, metallurgical and construction engineer with whom he must co-operate in his work around mines, dams and other engineering works. The first two years of this course are the same as those in Mining Engineering, since that course provides the essential preliminary work, and some mining and metallurgy are taken in the other years to broaden the knowledge of the geologist in the work of those with whom he must co-operate.

A candidate for a degree in Mining Geology will be required to submit satisfactory evidence that he has spent at least six months in field work. This work may consist of prospecting, work around mines, or service on geological field parties.

During each of the Third and Fourth years, a reading course in French, German, or Spanish will be required and the student will be expected to submit evidence, at the end of each of those years, of his ability to read geological papers in one of these languages.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subject referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 112.

FIRST YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus................	236	2	–	2	–
Business...................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Engineering Problems and Drawing................	166b	–	9	–	12
General Chemistry..........	84	2	–	1	–
Mineralogy.................	255, 258	2	1	–	3
Mining Laboratory..........	50	–	–	–	3
Physical Training............	280	–	2	–	2
Problems and Seminar........		–	3	–	3
Statics......................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English............	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory.........	89, 90	–	6	–	6
Descriptive Geometry........	162	1	–	1	–
Dyn. and Struct. Geology.....	198	1	–	–	–
Economics and Finance.......	123	1	–	1	–
Electricity..................	143	1	–	1	–
Elementary Petrography......	260	1	–	1	–
Engineering Problems and Drawing................	167b	–	3	–	10
Geology....................	195	–	–	2	–
Inorganic Chemistry..........	87a	1	–	–	–
Inorganic Chemistry..........	87b	–	–	1	–
Mechanics of Materials	4	2	–	2	–

SECOND YEAR SUBJECTS DEPT. 9—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Metallurgy	241	–	–	1	–
Mineralogy	261	–	2	–	2
Mining	51, 53	1	3	–	–
Physical Training	280	–	2	–	2
Problems and Seminar		–	3	–	3
Steam Engines	216	1	–	–	–
Surveying	272a, 273	1	6	1	–
Theory of Measurements	65	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88, 99	1	6	1	3
Assaying	45, 46	1	3	–	3
Economic Geology	202, 203a	1	3	3	3
Geological Field Work	193	–	–	–	–
Metallurgy	243	1	–	1	–
Mining	54	1	–	1	–
Petrography	262, 263	1	2	1	2
Physical Chemistry	98	2	–	2	–
Physics of Ore Dressing	64	1	–	1	–
Stratigraphic Geology	195a	2	3	2	3
Structural Geology Laboratory	198a	–	6	–	3
Survey Camp	275	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Economic Geology of Canada	203d	2	–	–	–
Engineering Economics	125	–	–	1	–
Geology, Mining	200	–	–	2	–
Geology, Pleistocene and Physiographic	194, 201	1	1	1	–
Geology, Precambrian	199	2	–	–	–
Geology, Precambrian and Economic	199a	2	3	2	3
Geophysics	322	2	9	2	9
Location of Mineral Deposits	203b	–	–	2	–
Mineralography	263b	–	2	–	2
Mining	55	1	–	1	–
Petrographic Methods	263a	1	1	1	1
Silicate Chemistry	116a	2	–	–	–
Thesis	204a	–	6	–	6

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 1. Applied Mechanics—Statics, means the course of lectures indicated by this number in the table of curriculum for the First Year on page 25.

APPLIED MECHANICS AND DESIGN OF STRUCTURES

1. Applied Mechanics—Statics. T. R. Loudon.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 2 hrs. per week, both terms.

This course of lectures deals with the fundamental principles of the laws of equilibrium of forces. These principles are applied to the determination of stresses in simple structures. Toward the end of the course an introduction to Mechanics of Materials is given.

Text: Analytical Mechanics for Engineers—Seely and Ensign.

2. Applied Mechanics—Dynamics. M. J. C. Lazier.

Departments 1, 2, 3, 6, 7, 8, 8a and 9, I Year; 2 hrs. per week, both terms.

This course of lectures is designed to extend the elementary principles of preparatory school mechanics to a more general viewpoint. Under the heading of Kinematics, the general equations of motion, both linear and angular, are developed.

Centres of mass and moments of inertia are calculated.

The principles of linear and angular momentum are dealt with and a fairly comprehensive course on effective and inertia forces as applied to engineering problems is given. The discussion of energy, work and power is extended as far as possible to practical problems.

Simple Harmonic Motion is also discussed.

Text: Tutorial Dynamics—Briggs and Bryan. Analytical Mechanics for Engineers—Seely and Ensign. Introduction to Mechanics—J. W. Campbell.

3. Applied Mechanics—Dynamics. T. R. Loudon, M. J. C. Lazier.

Department 3, II Year; 1 hr. per week, both terms.

This course of lectures extends the work of the First Year to more general applications, such as: bodies moving with general plane motion, compound pendulum, gyroscopic action. A short discussion of the fundamental theory of hydrodynamics with particular reference to determining stream line flow is included in these lectures.

Texts: Analytical Mechanics for Engineers—Seely and Ensign. Hydromechanics, Part II—Ramsey.

4. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Departments 1, 2, 3, 5, 6, 7, 8, 8a and 9, II Year; 2 hrs. per week, both terms.

In this course, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Reference book: Strength of Materials—Case.

5. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Department 4, II Year; 2 hrs. per week, both terms.

This course deals with the mathemactical consideration of stress and elasticity. Among the problems taken up are the consideration of riveted joints, theory of simple and continuous beams, the theory of columns and simple column footings.

Text: Strength of Materials—Boyd.

5*a*. Applied Mechanics—Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Depatrment 5, I Year; 2 hrs. per week, both terms.

This course of lectures deals with the determination of stresses in simple framed structures and beams. The course also includes an elaboration of the kinematics and kinetics of masses having particular reference to simple mechanical parts.

Text books: Analytical Mechanics for Engineers—Seely and Ensign.

5*b*. Applied Mechanics—Advanced Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Department 5, III Year; 1 hr. per week, both terms.

This course of lectures deals with advanced theory of harmonic motions as applied to stress analysis in engineering problems. The theories of elasticity are also elaborated in this course and applied to various types of structural examples.

6. Theory of Structures. C. R. Young, C. F. Morrison.

Department 1, III Year; 2 hrs. per week, both terms.

The work of the first term comprises a discussion of timber beams, and details, combined stresses, columns, trussed beams, box girders, and plate girders. A number of designs of structures and structural details are worked out in the class and drafting rooms.

The second term is given chiefly to moving loads, the design of a riveted truss highway span and the theory of railway truss spans. Problems relating to the design of typical structures of these types are worked out in the lecture and drafting rooms.

Texts: Modern Framed Structures, Part III—Johnson, Bryan and Turneaure. Structural Members and Connections—Hool and Kinne. Elementary Structural Problems—Young. A.I.S.C. Handbook, Steel Construction. Structural Design in Steel—Shedd.

7. Theory of Structures. C. F. Morrison.

Departments 2, 3, 5e, 5h, 6 and 8a, III Year; 1 hr. per week, both terms.

The work is practically the same as that for course 6 in the first term.

8. Structural Design. C. F. Morrison.

Department 4, III Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

The stress analysis of simple structures is discussed in this course. Practical problems on the design of beams, columns, piers, footings, and roof trusses are worked out in the drafting room. An introduction to reinforced concrete is also given.

Reference Book: Architectural Construction—Gay and Parker.

9. Mechanics of Materials. C. R. Young, W. L. Sagar.

Departments 3 and 5, II Year, Department 2, IV Year, 3 hrs. per week, one term; Department 1, III Year, 5 hrs. per week, one term.

This laboratory course is intended to give the student an introduction to the experimental study of the strength and elasticity of materials. It is intended that he shall acquire some familiarity with the construction and operation of testing machines and with the properties of ordinary materials of construction.

Reference: Junior Laboratory Course in Mechanics of Materials, Department of Civil Engineering; Municipal and Structural.

10. Stress Graphics. C. F. Morrison.

Departments 1 and 5e, III Year; 1 hr. per week, both terms.

This course of lectures deals with graphic methods of determining stresses in framed structures, the construction of shearing force diagrams, bending moment diagrams and influence lines. Some attention is also given to the principles of formula charting.

Text book: Graphic Analysis—Wolfe.

10*a*. Applied Elasticity. T. R. Loudon.

Department 1, III Year; 1 hr. per week, both terms.

In this course of lectures, the fundamental principles of elasticity are extended to apply to the determination of deformations and stresses in several of the well known types of structures and structural members where ordinary statical methods fail to give a solution of the problem.

Texts: Applied Elasticity—Timoshenko and Lessels. A Treatise on the Mathematical Theory of Elasticity—Love.

10*b*. Applied Elasticity. T. R. Loudon.

Department 5e, IV Year; 1 hr. per week, second term.

Deformations and stresses in plates and slabs variously supported and variously loaded, in railway rails and ties, in footings, in the heads of pressure vessels, and in structures composed of dissimilar materials subjected to temperature changes, shrinkage and flow.

11. Cements and Concrete. C. F. Morrison, W. L. Sagar.

Department 1, III Year; 1 hr. per week, both terms.

Department 8, III Year; 1 hr. per week, first term.

The manufacture, testing and use of Portland cement and the fundamentals of the theory of reinforced concrete are discussed in this course of lectures.

Reference books: Reinforced Concrete Design—Sutherland and Cliffoed. Reinforced Concrete Construction, Vol. I—Hool. Design of Concrete Structures—Urquhart and O'Rourke.

12. Theory of Structures. C. R. Young.

Departments 1a and 5e, IV Year; 2 hrs. per week, both terms.

The work comprised in this course of lectures concerns arches, suspension bridges, cantilever bridges, movable bridges, deflections, statically indeterminate systems, and secondary stresses. Problems based on the lectures are worked out in the drafting rooms.

Reference books: Modern Framed Structures, Part II—Johnson Bryan and Turneaure.

12*a*. Advanced Structural Analysis. C. R. Young, C. F. Morrison.

Department 5e, IV Year; 2 hrs., lecture, and 6 hrs. laboratory per week, both terms.

Flexural deformations are thoroughly investigated by the methods of single and double integration, by moment areas, shear areas, elastic weights, dummy loads, and Castigliano's first theorem. This is followed by a consideration of shear deformations, applications of the slope-deflection method and modifications of it, applications of the method of moment distribution, with modifications, stress determination by the method of least work, by Castigliano's second theorem, by the ellipse of elasticity method, the column analogy method and the fixed-point method.

13. Mechanics of Materials. C. R. Young, W. L. Sagar.

Department 1a, IV Year; a laboratory course of 3 hrs. per week, both terms.

This course of experiments is intended to give the student practice in investigating the elastic and physical properties of iron, steel, concrete, timber, etc., and in the use of instruments of precision designed for that purpose.

Reference book: Materials of Construction—Johnson.

13*a*. Engineering Mechanics. The staff in Civil Engineering.

Department 5e, IV Year; 6 hrs. per week laboratory, both terms.

Elastic properties of the materials of construction. Experimental determination of the elastic behaviour of, and stresses in, members and structures by means of mechanical and optical models.

14. Foundations, Retaining Walls and Dams. T. R. Loudon, W. J. Smither.

Department 1a, IV Year; 1 hr. per week, both terms.

This course of lectures is devoted to the design of the structures mentioned. The most approved forms of construction of retaining walls, footings, abutments, piers and dams are described, and typical designs are worked out in the class and drafting rooms.

Text books and books of reference: Retaining Walls for Earth—M. A. Howe. Walls, Bins and Grain Elevators—M. S. Ketchum. Design and Construction of Dams—E. Wegmann.

14*a*. Soil Mechanics. C. R. Young.

Department $1a_1$ and $1a_2$, IV Year; 1 hr. lecture per week, first term.

A course of lectures devoted to those physical and mechanical properties of soils of importance to the engineer, such as compressive and cohesive strengths, internal friction, stability in slopes, compressibility and other deformational characteristics, permeability and moisture retention. The bearing of these properties on the design and construction of engineering works is considered in detail.

15. Reinforced Concrete. C. R. Young.

Department 1a, IV Year; 1 hr. per week, both terms.

The theory of the strength of reinforced concrete elements including the beam, the slab, the T-beam, the column and the girderless floor, is continued in this course.

The analysis of the monolithic arch by the elastic theory is discussed, and the student is required in the drafting room to apply his knowledge to the design of simple structures.

Reference books: Principles of Reinforced Concrete Construction—Turneaure and Maurer. Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete—Caughey.

16. Structural Design. C. F. Morrison.

Department 4, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

In this course the properties of the materials used and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of columns, beams, and slabs are made. The lectures are supplemented by the working of problems in the drafting room.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Architectural Construction—Gay and Parker.

17. Structural Design. C. R. Young, W. J. Smither.

Department 1a, IV Year; 1 hr. per week, both terms.

Department 3, IV Year; 1 hr. per week, first term.

In this course of lectures consideration is given to such matters as mill construction buildings, economic arrangement of building frames, probable loadings for girders and columns, column eccentricities, crane runways, cable ways, wind bracing, and rigid frames.

Text books: Handbook of Building Construction—Hool and Johnson. Architects' and Builders' Handbook—Kidder-Parker.

18. Structural Design. C. R. Young, W. J. Smither.

Departments 1a, and 3, IV Year; 1 hr. per week, first term.

Consideration is given in this course to the various types of mill buildings, to the conditions governing their choice and to the design and details of construction in different materials. Designs of portions of mill buildings are worked out in the class and drafting rooms.

Text books: Steel Mill Buildings—Ketchum. Mill Buildings—Tyrrell.

19. Miscellaneous Structures. W. J. Smither.

Department 1a, IV Year; 1 hr. per week, second term.

In this course of lectures the application of theoretical principles to the design of a variety of structures is made. Among those structures discussed are transmission line towers, elevated tanks and their supporting towers, standpipes, large pressure pipes, sewers, culverts, small highway bridges, sub-surface tanks, aircraft structures and tall chimneys. Whenever possible the lecture work is followed up by designs in the drafting room.

20. Reinforced Concrete. C. F. Morrison.

Department 3, IV Year; 1 hr. per week, first term.

In this course the properties of the materials involved and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of columns, beams, floors and footings are made.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete Construction, Vol. I—Hool. Design of Concrete Structures—Urquhart and O'Rourke.

21. Structural Design. T. R. Loudon.

Department 4, V Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

In this course the students apply the principles of structural design to problems in which actual buildings are designed and detailed.

23. Vibration Engineering. M. J. C. Lazier.

Department 5e, IV Year; 1 hr. per week, both terms.

Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

23*a*. Vibration Laboratory. M. J. C. Lazier.

Department 5e, IV Year; 3 hrs. per week, both terms.

A series of experiments designed to give familiarity with the nature of vibrating systems and the causes, measurement and control of vibration in engineering problems. The assignment of experiments will depend on whether the student has elected for special study (*a*) Vibration of Structures, or (*b*) Vibration of Machines.

ARCHITECTURE, DRAWING AND PAINTING

25. History of Architecture. H. J. Burden.

Department 4, I Year; 1 hr. per week; both terms.

In this course the development of architecture and ornament is traced from pre-historic times to the close of the Byzantine Period.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. The Architecture of Ancient Greece—Anderson, Spiers, and Dinsmoor. The Architecture of Ancient Rome—Anderson, Spiers, and Ashby. The Grammar of Ornament—Owen Jones.

25*a*. History of Architecture. H. J. Burden.

Department 4, II Year; 1 hr. per week; both terms.

In this course the development of architecture and ornament is traced from the Romanesque Period to the end of the Gothic Period.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. Medieval Architecture—Arthur Kingsley Porter. Gothic Architecture in England — Francis Bond. The Grammar of Ornament—Owen Jones.

25*b*. History of Architecture. H. H. Madill.

Department 4, III Year; 1 hr. per week, first term.

In this course the architecture of the Renaissance in Italy and France is taken in detail.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. Architecture of the Renaissance in Italy—Anderson and Stratton. The Architecture of the Renaissance in France, Vol. 1 and 2—W. H. Ward. The Renaissance of Roman Architecture—T. G. Jackson.

25*c*. History of Architecture. E. R. Arthur.

Department 4, III Year; 1 hr. per week, second term.

This course of lectures covers the period 1500-1900 in England. Lectures on furniture are given in this course with special reference to the development of furniture in England from Mediaeval times.

Reference books: Growth of the English House—J. Alfred Gotch. A History of Renaissance Architecture in England, Vol. 1 and 2—R. Blomfield. History of Domestic Architecture in Britain during the Tudor Period—Thomas Garner and Arthur Stratton. Houses of the Wren and Early Georgian Period—Turnstall Small and Christopher Woodbridge. Mouldings of Wren and Georgian Periods—T. Small and C. Woodbridge. Robert Adam and his Brothers—John Swarbrick.

26. Functional Requirements of Buildings. A. S. Mathers.

Department 4, III and IV Years; 1 hr. per week, both terms.

In this course of lectures the principles underlying the planning of such large buildings as churches, departmental stores, theatres, schools, railway stations, etc., are discussed in detail.

27. Garden Design. H. B. Dunington Grubb.

Department 4, III Year. Special lectures, first term.

In this course the historical development of Garden Design is traced from earliest times; the study of sites; the influence of topography, orientation, access, etc., on the problems of design; site planning; the location of buildings; the solution of an actual problem on a typical site.

27*a*. Garden Design. H. B. Dunington Grubb.

Department 4, IV Year. Special lectures, first term.

The work of the previous year is continued and a problem is set in the studio involving principles of both architectural and garden design.

28. Elements of Architectural Form. E. R. Arthur.

Department 4, I Year; 1 hr. per week, both terms.

The elements of architectural form include the study of doors, windows, columns, wall treatment, roofs, mantels, chimney stacks, etc. These are examined without regard to particular style and from the standpoint of design rather than construction.

Reference books: Theory and Elements of Architecture, Vol. 1, Part 1—Robert Atkinson and Hope Bagenal. Fragments Antique, Vol. I and II—D'Espouy. The English Fireplace—L. A. Shuffrey. The Design of Lettering—Egon Weiss. Current Architectural Magazines.

30. History of Fine Art. C. W. Jefferys.

Department 4, IV Year; 1 hr. per week, both terms.

The course consists of an outline of the history and development of painting and of the minor pictorial arts from the earliest time until the present day, followed by an outline of the history and development of the different eras of sculpture ranging from the primitive to the present day.

31. Architectural Design. H. H. Madill, E. R. Arthur, W. E. Carswell.

Department 4, I Year. 12 hrs. per week, both terms.

This comprises work done in the studio, including lettering, drawing, and rendering such elementary studies as a door, a window, etc., and exercises in simple composition.

An elementary design is carried to the stage of working drawings. Furniture, mantels, etc., in the Royal Ontario Museum are drawn to scale.

31*a*. Architectural Design. E. R. Arthur, Mackenzie Waters, W. E. Carswell.

Department 4, II Year. 15 hrs. per week, both terms.

This course is given by means of individual instruction in the studio, and by criticism of the solutions of different problems set during the year. It is in this course that the student begins the serious study of design; continued practice in architectural drawing and rendering affords the training necessary to make the student a proficient draughtsman.

31*b*. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4, III Year. 20 hrs. per week, both terms.

This course is given by individual instruction in the studio and by criticism of solutions of problems set during the year. The greater part of the course is devoted to problems in design and forms a continuation of the course given in the preceding year.

One of the students' designs of a building is carried through to the stage of working drawings.

31*c*. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4, IV Year. 20 hrs. per week, both terms.

This course is a continuation of the work of the preceding years, being given by individual instruction in the studio and criticisms of the solution of problems set during the year.

31*d*. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4, V Year. 26 hrs. per week, both terms.

The course of the preceding year is continued in more advanced problems.

One of the students' designs of a building is carried through to the stage of working drawings.

31*e*. Architectural Engineering. H. H. Madill, T. R. Loudon.
Department 4, IV Year; Architectural Engineering Option.
In this course lectures on structural design and layout are given and problems are worked out in the studio. The work is coordinated with problems set in architectural design.

31*f*. Architectural Engineering. H. H. Madill, T. R. Loudon.
Department 4, V Year; Architectural Engineering Option.
In this course the design and preparation of working drawings and structural details of work of a monumental character are carried on in the studio. The student is also required to take such lectures as are prescribed from time to time. The work is coordinated with problems set in architectural design.

32. Theory of Architectural Planning. E. R. Arthur.
Department 4, II Year.
In this course the general principles of planning of buildings from the small to complex problems are demonstrated. In the Second Term actual plans of libraries, banks, houses, etc., are studied as an aid to problems in design and a preliminary to work in the following year.
Reference books: Elements of Form and Design in Classic Architecture—Arthur Stratton. The Modern House—F. R. S. Yorke. The Smaller English House of the Later Renaissance, 1660-1830—A. E. Richardson and H. D. Eberlein. The Plan Requirements of Modern Buildings—V. O. Rees.

33. Architectural Composition. E. R. Arthur.
Department 4, III Year.
This course consists of a series of lectures on the theory of architectural design, the analysis of composition, proportion, scale, etc.
Illustrated lectures are given on Modern Architecture.
Reference books: Principles of Architectural Composition—Howard Robertson. Modern Architectural Design — Howard Robertson. The Architecture of Humanism—Geoffrey Scott. The Gothic Revival—Kenneth Clark. Towards a new Architecture—Le Corbusier. The Study of Architectural Design—J. F. Harbeson. Current magazines from England, France, Italy, Germany and the United States which are available to the students in the School Library.

34. Architectural Aspects of Town Planning. E. R. Arthur.
Department 4, V Year; 1 hr. per week, second term.
In this course of lectures the historical development of town planning is traced with particular reference to the Axial Planning of the Renaissance, public squares, the grouping of buildings and the placing of monuments and street Architecture.

35. Freehand Drawing and Water Colour Painting. H. J. Burden, W. E. Carswell.

Department 4, I Year; 2 hrs. per week, both terms.

Drawing from still life, primary free hand perspective, primary pencil, charcoal, and pen and ink rendering.

35*a*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Department 4, II Year; 2 hrs. per week, both terms.

Drawing and monochrome painting from still life, drawing from the cast, pencil, pen and ink, and monochrome rendering, primary water colour, drawing from landscape and natural objects.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*b*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Department 4, III Year; 2 hrs. per week, both terms.

Drawing from the cast, water colour from still life, water colour rendering, drawing from landscape and natural objects.

Students who are sufficiently advanced are admitted to the Fourth Year Life Drawing Class.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*c*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Departent 4, IV Year; 2 hrs. per week, both terms.

Water colour from still life and from landscape, drawing from life.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*d*. Water Colour and Life Drawing. C. W. Jefferys.

Department 4, V Year; 2 hrs. per week, both terms.

Advanced water colour drawings and murals; drawings from life.

36. Modelling. Frederick Coates.

Department 4, II Year; 2 hrs. per week, both terms.

Scale models of architectural forms.

36a. Modelling. Frederick Coates.

Department 4, III Year; 2 hrs. per week, both terms.

Scale models of simple buildings.

36*b*. Modelling. Frederick Coates.

Department 4, IV Year; 2 hrs. per week, both terms.

Scale models of buildings and settings.

37. Building Construction. H. H. Madill.

Department 4, I Year; 1 hr. per week, second term.

Instruction is given in elementary construction using common building materials. The detailing of doors, windows, roofs, etc.

Reference books: Architectural Building Construction, Vol. 1—Jaggard and Drury. Building Construction, Vol. 1—V. F. Mitchell. Architectural Graphic Standards—Ramsey and Sleeper.

38. Building Materials. H. H. Madill.

Department 4, IV Year; 2 hrs. per week, both terms.

Properties and the use of the various materials used in building are studied from the architectural rather than the structural viewpoint.

A small exhibition room has been set aside in which examples of the most modern materials and devices are displayed. This room is open to the student at all times.

Reference books: Architectural Construction, Vol. 1—Voss and Henry. Builders Materials—R. F. B. Grundy. Brickwork—W. R. Jaggard. Lumber and its uses—R. S. Kellog. Building Construction, Vol. 1 and 2—Jaggard and Drury. Rivingtons Notes on Building Construction, Part I and II—W. N. Twelvetrees.

39. Sanitary Science. H. H. Madill.

Department 4, IV Year; 1 hr. per week; both terms.

Modern plumbing, its design and installation, drainage, sewerage disposal and water supply.

Reference books: Mechanical and Electrical Equipment for Buildings—Gay and Fawcett.

39*a*. Professional Practice. H. H. Madill.

Department 4, V Year; 1 hr. per week, both terms.

This course of lectures is designed to give an understanding of the professional character of the practice of architecture. In it are discussed the ethical, business and legal relations of the architect to clients, contractors, craftsmen, engineers and the professional bodies. The methods of office practice are also discussed.

Reference books: Architectural Practice and Procedure—H. H. Turner. The Architects Law Manual—C. H. Blake. The Law of Architecture and Building—C. H. Blake. Handbook of Architectural Practice A.I.A. Contract Forms of R.A.I.C. Code of Architectural Competitions O.A.A. Standard Specifications A.I.A.

40. Heating and Air Conditioning. A. Wardell.

Department 4, V Year; 1 hr. per week, both terms.

In this course of lectures the different systems of heating, ventilating and air conditioning of buildings are discussed.

40*a*. Architectural Economics. W. S. Wilson.

Department 4, V Year; 1 hr. per week, both terms.

A course of instruction in the various methods of preparing estimates, together with practical work in taking off quantities.

41. Vacation Work. H. H. Madill.

Department 4, II Year.

Each student is required to submit a set of twenty pages of notes on building construction on or before the opening day of the session. These notes are to consist of freehand pencil drawings with figured dimensions. Instruction as to the nature of these notes will be given by Prof. Madill before the close of the previous session.

42. Vacation Work. E. R. Arthur.

Department 4, III Year.

Each student is required to submit on or before the opening day of the session a set of measured drawings of existing buildings, and details of buildings, the building first to be approved by Prof. Arthur, who will also decide the number and size of the drawings to be made. The record of measurements must be preserved in a notebook which will be submitted with the final drawings.

43. Vacation Work. H. J. Burden, W. E. Carswell.

Department 4, IV Year.

Each student is required to submit on or before the opening day of the session a set of at least seven outdoor sketches in water colour, pen and ink, or pencil. The minimum size for each sheet will be $9'' \times 12''$. Of these sketches at least four will be in pencil and at least three will be of an architectural character.

44. French. Miss J. C. Laing.

Department 4, I Year; 2 hrs. per week, both terms.

A. Reading of texts illustrative of French life; brief study of the geography of France; practice in conversation.

B. Outline of the history of Western Europe to 1500 A.D., with special reference to development of French and Italian civilization and culture.

Reference books: The Ordeal of Civilization—James Harvey Robinson. History of Medieval Europe—Thorndike. A History of France—William S. Davis. A short History of France, A Short History of Italy—Henry Dwight Sedgwick. Autobiography—B. Cellini. Leonardo da Vinci—Merejowski.

44*a*. French. Miss J. C. Laing.

Department 4, II Year; 2 hrs. per week, both terms.

A. Continuation of the work of the I Year.

Text: Michelet's Histoire de France—Buffum.

B. Outline of the history of Western Europe during the Renaissance period.

Reference books: The Renaissance and the Reformation—Lucas. A Political and Cultural History of Modern Europe, Vol. 1—Hayes. A Short History of France, A Short History of Italy—Sedgwick. National History of France, The Century of the Renaissance—Batiffol. The Seventeenth Century—Boulenger.

44*b*. French. Miss J. C. Laing.

Department 4, III Year; 1 hr. per week, both terms.

A. Continuation of the work of the II Year.

B. Brief outline of history of the French Revolution and modern France.

Reference books: A Short History of France—Sedgwick. National History of France, The Eighteenth Century—Stryienski. French Society in the Eighteenth Century—Ducros.

ASSAYING, MINING AND ORE DRESSING

The work in Mining is directed more to the development of the proper attitude of mind towards mining problems than to the teaching of actual mining methods.

The teaching of Assaying has a two-fold function. The first is to give the student a working knowledge of the practice of the art, so that he can earn money as an assayer on graduation and use this as a stepping-stone to other positions. The second is to use the assaying laboratories for the training of students in certain important phases of engineering methods. The size of the apparatus, the completeness of the processes in short intervals of time, the extreme accuracy of results when so desired, the relation of the extent of error to time and method, the similarity of the academic laboratory to the field laboratory—all these permit an unrivalled opportunity for driving home much broad engineering philosophy. The assaying processes and apparatus lend themselves peculiarly well to the development of a proper perspective in regard to errors and accuracy in measurements.

The study of Ore Dressing, when accompanied by laboratory work in a well-equipped ore dressing laboratory, is one of the most important of the Mining Engineering subjects. Not only is the mechanical treatment of ores a very important branch of Mining Engineering, but the mental processes involved in a study of the fundamental principles underlying the art, and the compromise necessary for field practice form one of the best fields for the development of engineering philosophy. From these points of view, the ore dressing laboratory is exceptionally well equipped.

45. Assaying. J. T. King.

Departments 2, 8 and 9, III Year; 1 hr. per week, first term.

A first course of lectures on the theory of fire assaying. Emphasis is laid not only on the chemical and metallurgical principles involved, but upon the errors inherent in operators as well as in methods.

Text Book: Manual of Fire Assaying—Fulton and Sharwood.

46. Assaying. J. T. King.

Departments 2, 8 and 9, III Year; 3 hrs. per week, both terms.

A laboratory course in the determination of the precious metals in ores, milling and metallurgical products. Scorification and crucible assays of ores and products, pure and impure, fluxes, slags and solutions. Buckboard practice, ores with metallics. Copper and lead by electrolysis. Students are expected to do their later assays with despatch and a reasonable degree of accuracy. Neatness of work is required.

47. Assaying. J. T. King.

Departments 2 and 8, IV Year; 1 hr. lecture per week, second term.

A continuation of course 45. Complex ores. Combination assays. The sampling and assay of bullion. The platinum group metals. Checks and corrections.

48. Assaying. J. T. King.

Departments 2 and 8, IV Year; 3 hrs. per week, second term.

An advanced laboratory course in which some of the methods of course 47 are used.

49. Assaying. J. T. King.

Department 6, III Year; 3 hrs. per week, first term.

An introductory laboratory course for chemical engineers. Some lecture instruction is given. An abbreviation of courses 45 and 46.

50. Mining. H. E. T. Haultain, F. C. Dyer.

Departments 2 and 9, I Year; 3 hrs. per week, second term.

A laboratory course, including some lectures, being an introduction to certain mining and milling machinery and methods.

51. Mining. H. E. T. Haultain.

Departments 2, 8 and 9, II Year; 1 hr. per week, first term.

An introductory course of lectures.

52. Mining. H. E. T. Haultain.

Department 8, II Year; 1 hr. per week, second term.

An extension of course 51.

53. Mining. F. C. Dyer.

Departments 2 and 9, II Year; 3 hrs. per week, first term.

A continuation of course 50. Rock drills, sampling methods, use of explosives.

54. Mining. H. E. T. Haultain, F. C. Dyer.
Departments 2 and 9, III Year; 1 hr. per week, both terms.
Principles of mining.

55. Mining. H. E. T. Haultain.
Departments 2 and 9, IV Year; 1 hr. per week, both terms.
Special problems, estimates, reports.

56. Mine Cost Finding and Management. H. E. T. Haultain.
Department 2, IV Year; 1 hr. per week, both terms.
One of the fundamental features that must not be lost sight of by the mining engineer is, that his work is designed primarily for purposes of financial profit. This course of lectures deals with details from this point of view. The total cost of a ton of ore requiring as it does an understanding of the problems of amortization, is first dealt with in a broad way. Then are considered various problems of cost finding, leading on to problems of time and motion study which are essential to the development of the fine points of the art in any particular mining problem. The latter part of the course deals with problems of management, the relation of members of the staff to each other, and the relations of the staff to labour.

57. Mine Ventilation and Allied Problems. The Staffs in Mining and Mechanical Engineering.
Department 2, IV Year; 2 hrs. lectures and 3 hrs. laboratory per week, first term.

58. Ore Dressing. H. E. T. Haultain, F. C. Dyer.
Departments 2 and 8, III Year; 1 hr. per week, both terms.
The general principles of Ore Dressing.

59. Ore Dressing. F. C. Dyer.
Departments 2 and 8, III Year; 6 continuous hrs. per week, second term.
Work with crushing machinery, principles of crushing and grading, screen analyses, concentration with gravity separation apparatus, etc.

60. Ore Dressing. H. E. T. Haultain, F. C. Dyer.
Departments 2 and 8, IV Year; 1 hr. per week, both terms.
Course 58 continued, study of flow sheets and special problems.

61. Ore Dressing. F. C. Dyer.
Departments 2 and 8, IV Year; 6 continuous hrs. per week, first term.
Advanced work with ore dressing appliances, ore testing and check mill runs.

62. Ore Dressing. F. C. Dyer.
Department 6m, IV Year; 1 hr. per week, both terms.
General principles of Ore Dressing.

63. Ore Dressing. F. C. Dyer.

Department 6m, IV Year; 1 period of 6 hrs. per week, second term.

Department 8a, IV Year; 3 hrs. per week, both terms.

Principles of sampling, crushing and grading, screen analyses, concentration with gravity separation apparatus, flotation, ore testing, etc.

64. Physics of Ore Dressing. F. C. Dyer.

Departments 2, 8 and 9, III Year and Departments 6m and 8a, IV Year; 1 hr. per week, both terms.

Ore dressing methods involve a study of the laws governing the phenomena of surface tension, capillarity and colloidal solutions, in addition to those of hydrostatics and certain phases of hydraulics. This is embodied in a special course of lectures in conjunction with laboratory work in the ore dressing laboratory.

65. Theory of Measurements. H. E. T. Haultain, F. C. Dyer.

Departments 2 and 9, II Year; 1 hr. per week, first term.

This title is not an entirely suitable one for this course of lectures because it is generally applied to a study of the philosophy of extremely accurate measurements. The mining engineer has to continually make satisfactory use of measurements with a wide range of inaccuracy. This course of lectures deals with the philosophy underlying the causes of these errors and the practical application of such approximations. The opportunity is taken in these lectures to deal with the subject of illustrating measurements by graphs.

66. Introductory Research. H. E. T. Haultain, F. C. Dyer.

Department 2, III Year; 3 hrs. per week, first term.

This is a laboratory course including some lectures and is a preparation for the thesis of the Fourth Year.

67. Thesis.

Department 2, IV Year; 7 hrs. per week, first term; 10 hrs. per week, second term, in continuous periods.

Thesis in this department consists mainly in reports on original work done in the laboratories. In the Third Year the subject "Introductory Research" paves the way for the thesis. By October 15th the student decides on the subject of his thesis in consultation with his professors. After this is decided the student uses his own initiative in the development of his work.

The thesis is divided into three parts. The first part, which is handed in not later than October 15th, contains the title, a statement of what the title is meant to convey and an outline of the work that is proposed to be done. The second part is handed in during the first week of January and contains a report of progress to date and enables the professor in charge to keep in closer touch with the work. The third and final part is handed in a week before the examinations and is a report of progress to date with final conclusions. The three parts combined constitute the thesis.

69. Vacation Work. H. E. T. Haultain.

Department 2, III Year.

This is a series of letters written during the summer vacation, dealing with various aspects of a mining engineer's work. These are intended to direct and help the student's powers of observation, analysis and criticism as well as being exercises in the art of lucid technical expression.

Special instructions will be issued in connection with these letters.

70. Vacation Work. H. E. T. Haultain.

Department 2, IV Year.

Special instructions will be given in connection with this work.

ASTRONOMY AND GEODESY

71. Astronomy, Elementary. P. M. Millman.

Department I, II Year; 1 hr. per week, both terms.

A course in descriptive Astronomy, explaining the ordinary astronomical terms, and describing the various celestial bodies and their motions. In the evenings opportunity will be given for identifying the stars and for observing with telescopes.

Text book: Elements of Astronomy—Fath.

72. Astronomy and Geodesy. S. R. Crerar.

Department 1, III Year; 2 hrs. per week, both terms.

The course of lectures deals with the determination of time, latitude, longitude and azimuth, by methods adapted to the use of the surveyor's transit and the sextant. It is designed to fulfil the requirements of the final examinations for Ontario and Dominion Land Surveyors.

In Geodesy an account is given of the principles and methods of a secondary triangulation survey, also of the principles involved in the North-west system of survey.

Text books: Practical Astronomy as applied to Geodesy and Navigation—Doolittle. Notes on Practical Astronomy and Geodesy. Nautical Almanac.

73. Field Work. S. R. Crerar.

Department 1, III Year; about 2 hrs. per week, first term.

The practical work in this subject comprises observations in the field with the transit and sextant for the determination of time, latitude and azimuth by the methods described in the lectures and the solution of related problems.

74. Astronomy (Advanced). J. W. Melson.

Department 1b, IV Year; 2 hrs. per week, both terms.

The lecture course in this subject comprises the theory and adjustment of the instruments used in connection with a geodetic survey; the methods of taking and reducing observations for time, longitude, latitude, and azimuth. with the precision required on such a survey; and other matters relating to these subjects.

75. Geodesy and Metrology. W. M. Treadgold.

Department 1b, IV Year; 2 hrs. per week, both terms.

The lecture course includes a description of the methods of measuring base lines and the angles of a triangulation; the geometry of the spheroid with applications to geodetic problems; the computation of geodetic positions; the solution of large triangles on the earth's surface, and the adjustment of a triangulation; trigonometric and precise spirit levelling; the determination of the figure of the earth by arc measurements, and by the pendulum; the theory of map projections, etc.

76. Astronomy, Geodesy and Metrology. W. M. Treadgold, J. W. Melson.

Department 1b, IV Year; about 23 hrs. per week, both terms.

The practical work in the above subjects includes the observation of meridian transits for time and longitude determinations, and of prime vertical transits for latitude, with the astronomical transit instrument; the observation of meridian zenith distances of stars, and of azimuths at elongation for latitude, with the alt-azimuth; theodolite observations for azimuth; observations for latitude with the zenith telescope; the investigation of the constants of the instruments used, and the reduction of all observations; the measurement of a base line with the steel tape and with invar wires, and the determination of the constants of the tape; the measurements of the angles of a triangulation and the adjustment of the angles of network of triangles, etc. A portion of this work will be taken at the University Survey Camp. (See course 275.)

BIOLOGY

80. Elementary Biology. A. J. V. Lehmann.

Department 6, I Year; 3 hrs. per week, second term.

A lecture and laboratory course on biological principles.

CHEMISTRY AND CHEMICAL ENGINEERING

84. General Chemistry. E. G. R. Ardagh.

Departments 1, 2, 3, 7 and 9, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

An advanced course in inorganic chemistry with industrial applications.

85. General Chemistry. E. A. Smith.

Deparments 5, 6, 8 and 8a, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

An advanced course in chemical theory with industrial applications.

86. Inorganic Chemistry. L. J. Rogers.

Department 5, I Year; 3 hrs. per week, both terms.

Department 6, I Year; 12 hrs. per week, both terms.

Department 8a, I Year; 9 hrs. per week, first term; 15 hrs. per week, second term.

A laboratory course of quantitative experiments illustrating the use of the sensitive balance, and confirming the fundamental laws of chemistry; qualitative inorganic analysis; quantitative analysis of pure salts.

Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

87*a*. Inorganic Chemistry A. E. G. R. Ardagh.

Departments 1, 2, 3, 6, 7, 8, 8a and 9, II Year; 1 hr. per week, first term.

A continuation of courses 84 and 85 dealing principally with the metals.

87*b*. Inorganic Chemistry B. E. G. R. Ardagh.

Departments 2, 6, 8, 8a and 9, II Year; 1 hr. per week, second term.

A continuation of courses 84 and 85.

Text book: General Chemistry—Deming.

88. Analytical Chemistry. L. J. Rogers.

Departments 2, 6, 8, 8a and 9, III Year; 1 hr. per week, both terms.

A lecture course on the principles of chemical analysis; select gravimetric and volumetric methods; technical analysis.

89. Analytical Chemistry. E. A. Smith, R. R. McLaughlin.

Departments 1 and 3, II Year; 6 hrs. per week, second term.

Departments 2 and 9, II Year; 6 hrs. per week to Dec. 1st.

Department 7, II Year; 6 hrs. per week, first term.

Laboratory course in qualitative and quantitative analysis.

90. Analytical Chemistry. E. A. Smith.

Departments 2 and 9, II Year; 6 hrs. per week, from Dec. 1st.

A laboratory course in the gravimetric determination of metals and acids, with elementary volumetric analysis.

91. Analytical Chemistry. L. J. Rogers.

Department 8, II Year; about 14 hrs. per week, first term; about 13 hrs. per week, second term.

A laboratory course comprising gravimetric and volumetric methods, acidimetry and alkalimetry.

Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

92. Analytical Chemistry. L. J. Rogers.

Departments 6 and 8a, II Year; about 100 hrs., to Dec. 1st.

A laboratory course in quantitative chemical analysis; inorganic preparations.

Text book: Analytical Chemistry, Vol. II—Treadwell-Hall.

93. Engineering Chemistry. E. A. Smith.

Departments 1, 3, 5, 6, 7 and 8a, II Year; 1 hr. per week, first term.

A lecture course consisting of a study of the industrial production and application of heat, and of the chemistry of fuel and the products of combustion.

94. Industrial Chemistry. J. W. Bain.

Departments 6 and 8a, II Year; 1 hr. per week, both terms.

A lecture course on the manufacture of salts, acids, alkalies and inorganic chemicals.

94*a*. Industrial Chemistry and Technical Analysis. E. G. R. Ardagh.

Departments 6 and 8a, II Year; about 70 hrs., second term.

An introductory laboratory course in industrial chemistry containing experiments on petroleum products, fertilizers, etc., preparation of inorganic salts on a pound scale.

95. Organic Chemistry. M. C. Boswell.

Departments 1, 3 and 7, II Year; 1 hr. per week, second term.

A lecture course upon some of the elementary principles of Organic Chemistry and their application to selected industries.

96. Industrial and Laboratory Synthesis in Organic Chemistry. M. C. Boswell.

Department 6, II Year; 2 hrs. per week, both terms.

A discussion of the chemical reactions used in synthesis in the laboratory and the factory, and of the conditions under which compounds are brought into reaction, the conditions used for securing high yields, and the methods employed for isolating compounds from reaction mixtures both in the laboratory and in industry.

97. Industrial and Laboratory Methods of Synthesis. M. C. Boswell, R. R. McLaughlin.

Department 6, II Year; about 115 hrs., second term.

A laboratory course accompanying lecture course 96.

98. Physical Chemistry. F. B. Kenrick.

Departments 5, 6, 8a and 9, II Year; 2 hrs. per week, both terms.

A course of lectures on the elements of chemical mechanics, and the theory of solutions.

99. Analytical Chemistry. L. J. Rogers.

Departments 2 and 9, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.

A laboratory course on the technical analysis of ores and furnace products.

100. Industrial Chemistry and Technical Analysis. E. G. R. Ardagh.

Departments 6 and 8a, III Year; 155 hours.

A continuation of laboratory course 94a, containing experimental work on coal, petroleum, illuminating gas, silicates, sugars, starch, etc., potentiometric determination of hydrogen-ion, preparation of inorganic salts on a pound scale. Instruction in glass blowing is given in this course.

Text book: American Society for Testing Materials. Engineering Chemistry—Stillman. Liquid and Gaseous Fuels—Lewes and Kershaw. Fuels and their Combustion—Haslam and Russell. Determination of Hydrogen Ions—Clark. Technical Methods of Chemical Analysis—Lunge. Handbook for Cane Sugar Manufacturers—Spencer.

101. Analytical Chemistry and Phase Rule. L. J. Rogers, J. T. Burt-Gerrans.

Department 8, III Year; about 6 hrs. per week, second term.

A laboratory course in analysis and phase rule.

102. Engineering Chemistry. J. W. Bain, E. G. R. Ardagh.

Departments 1, 2, 3, 6, 7, 8 and 8a, III Year; 1 hr. per week, both terms.

A lecture course on the application of chemistry to engineering problems: air, water, corrosion of metals, explosives, petroleum products, rubber, synthetic resins, etc.

103. Industrial Chemistry. E. G. R. Ardagh.

Department 6, III Year; 1 hr. per week, both terms.

A lecture course on petroleum and its products, coal tar and its products, fats, oils, soap, sugar, starch, rubber, fermentation industries, etc.

104. Chemical Engineering. J. W. Bain.

Departments 6 and 8a, III Year; 1 hr. per week, both terms.

A lecture course on the theory and practice of heat transfer, evaporation, filtration and other industrial operations.

Text book: Elements of Chemical Engineering—Badger and McCabe.

104*a*. Chemical Engineering. Staff in Chemical Engineering.

Department 6, III Year.

A laboratory course in Chemical Engineering introductory to Course 111.

105. Industrial and Laboratory Synthesis in Organic Chemistry. M. C. Boswell.

Department 6, III Year; 2 hrs. per week, both terms.

A continuation of Lecture Course 96.

106. Industrial and Laboratory Methods of Synthesis in Organic Chemistry. M. C. Boswell, E. A. Smith, R. R. McLaughlin.

Department 6, III Year; 125 hrs.

Laboratory and industrial reactions are performed, in some cases using the following small scale industrial apparatus: filter press, sulphonator, tanks for precipitation, electric stirrer, vacuum evaporator, vacuum drier, fusion pot, ball mill, high pressure autoclaves, pumps for transferring liquids, and materials for constructing electric tube furnaces and thermocouples.

Text books: Manual of Industrial Chemistry (Organic)—Rogers. Practical Methods of Organic Chemistry—Gattermann. Unit Processes in Organic Synthesis—Groggins. Die Methoden der organischen Chemie—Houben-Weyl.

107. Electrochemistry. W. L. Miller, J. T. Burt-Gerrans.

Departments 6, 7 and 8, III Year; 2 hrs. per week, first term.

A lecture course on elementary electrochemistry, illustrated by experiments.

108. Electrochemistry. W. L. Miller, J. T. Burt-Gerrans.

Departments 6, 7 and 8, III Year; 3 hrs. per week, first term.

A laboratory course in quantitative measurements to accompany course 107.

109. Inorganic Chemistry. J. W. Bain.

Department 6, IV Year; 2 hrs. per week, both terms.

A lecture course on chemical theory.

110. Catalysis in Organic Chemical Industry. M. C. Boswell.

Department 6, IV Year; 1 hr. per week, both terms.

This lecture course is a continuation of Courses 96 and 105 and embraces as well a discussion of the methods used in several of the industries employing catalysts.

110*a*. Organic Chemistry. M. C. Boswell.

Department 8a, II Year; 1 hr. per week, both terms.

Departments 5s and 5g, III Year; 1 hr. per week, both terms.

A lecture course on the general reactions and methods of synthesis of carbon compounds.

Text book: Organic Chemistry—Perkin and Kipping.

111. Chemical Engineering and Industrial Organic Chemistry. Staff in Chemical Engineering.

Department 6, IV Year.

A laboratory course involving quantitative measurements employing the following standard apparatus: still, heat interchanger, absorption column, and filter press. The experiments have been selected to furnish experimental data for the confirmation of some of the principles and mathematical expressions discussed in Lecture

Course 104. The course also includes experiments in industrial chemistry supplementary to Course 106.

Text books: Elements of Chemical Engineering—Badger and McCabe. Distillation Principles and Processes—Sydney Young.

112. Industrial Chemistry and Chemical Engineering. J. W. Bain.

Department 6, IV Year; 1 hr. per week, both terms.

A lecture course on selected subjects in chemical technology and chemical engineering.

113. Research. The senior staff in Chemical Engineering.

Department 6, IV Year.

In this course, which occupies about three-quarters of the total time of the year, a research problem is given to each student. This provides experience in searching the primary sources of scientific information and in devising analytical methods and designing apparatus applicable to the new problems. Each student is obliged to write a thesis embodying the results of his search of the original literature and his own experimental work. Thus this course serves as a preparation for the field of research work; and those students who, by ability, taste, and temperament, are fitted for research pass naturally either into industrial research or into the graduate school of the University to pursue further work in this field.

114. Electrochemistry. J. T. Burt-Gerrans.

Department 6e, 7e, and 8, IV Year; 2 hrs. per week, both terms.

An advanced lecture course on the theory of solutions and electrolysis, and the application to the practice of electro-deposition and electrolytic refining of metals. The course also includes lectures on the electric furnace with special consideration of efficiency.

Reference books: Electrometallurgy—Borchers. Electrochemistry—Le Blanc. Electrochemistry—Luepke. Principles of Applied Electrochemistry—Allmand and Ellingham. The Electric Furnace—Stansfield. The Electric Furnace—Pring.

115. Electrochemistry. J. T. Burt-Gerrans.

Departments 6e, 7e and 8, IV Year.

A laboratory course accompanying course 114.

116*a*. Silicate Chemistry. J. B. Ferguson.

Departments 8a and 9, IV Year; 2 hrs. per week, first term.

The application of phase rule to the chemistry of refractory materials.

ECONOMICS AND BUSINESS ADMINISTRATION

121. Business. R. R. Grant.

Departments 1, 2, 3, 6, 7, 8, 8a and 9, I Year; 1 hr. per week, second term.

A lecture course on the principles underlying accounting and general business methods of a simple nature in order to enable the student to understand and prepare simple financial reports.

122*a*. Technical English. W. J. T. Wright.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 1 hr. per week, both terms.

A lecture course on the expression of ideas and the compilation and writing of engineering reports and letters; technical exposition; the necessity of accurate expression in professional writing; the value of reading.

122*b*. English. W. J. T. Wright.

Department 4, II Year; 1 hr. per week, both terms.

This course of lectures includes a discourse on the literature which refers either directly or indirectly to architecture and the arts. Books are reviewed and discussed in round-table talks.

123. Economics and Finance. C. H. Mitchell.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, II Year; 1 hr. per week, both terms.

An introduction to the study of Economics. The course will deal in an elementary manner with the following:

(1) Scope of Economics.
(2) Economic Geography.
(3) Theory of Value, Supply and Demand.
(4) Theory of Production and Distribution.
(5) Structure of Industry and Social Conditions.
(6) Money, Banking and Finance.
(7) Economics of Canada with special reference to the relation of Engineering to Finance.

Text books: Economics for the General Reader—Clay. Supply and Demand—H. D. Henderson. Annual Financial Reviews.

124. Commercial Law. F. C. Auld.

Departments 4 and 7, III Year; 1 hr. per week, both terms.

General Principles of the Law of Contracts, Principal and Agent, Partnership and Limited Companies with special reference to the Companies Acts. General view of the following:—Negotiable Instruments, Sale of Goods, Bills of Sale and Chattel Mortgages, Suretyship and Guarantee.

Text book: Falconbridge and Smith—Manual of Canadian Business Law.

125. Engineering Economics. C. R. Young.

Departments 1, 2, 3, 5c, 5s, 7, 8 and 9, IV Year; 1 hr. per week, second term.

A series of lectures on the principles by which the economic practicability of a project is judged and the comparison of competing proposals is made. Consideration is given to first cost and annual cost, methods of estimating, fixed charges and operating expenses,

financing of engineering projects, valuation and appraisals. Special attention is given to depreciation and the methods of providing for it. Typical numerical problems are discussed and solved.

Text books: Engineering Economies—Fish. Financial Engineering—Goldman. Principles of Engineering Economy—Grant.

126. Engineering Law. R. E. Laidlaw.

Department 1, IV Year; 1 hr. per week, both terms.

Departments 3, 6 and 7, IV Year; 1 hr. per week, first term.

A course of lectures co-ordinating engineering practice and law as contained in legislation such as that of the Railway Act, Municipal Act, Public Health Act, Surveys Act, Ditches and Watercourses Act, Mining Act, Arbitration Act, Workmen's Compensation Act, and the Acts respecting Patents, Copyrights, Trade Marks, Trade Designs, etc. Consideration is also given to the legal aspects of engineering relations, promotion and organization of companies, town planning and surveys, building trades, factories, shops, and office buildings.

127. Contracts and Specifications. C. R. Young.

Departments 1, 4, and 8, IV Year; 1 hr. per week, second term.

This course of lectures deals with the fundamental principles of contract and specification writing. The critical examination of typical specifications and agreements by the class, forms an essential feature of the instruction.

Text book: Elements of Specification Writing—Kirby.

128. Management. C. R. Young.

Department 1, IV Year; 1 hr. per week, first term.

A series of lectures dealing with the fundamental principles upon which management is based. The possibilities of effective management are indicated and its basis is shown to exist in suitable organization, adequate equipment and smooth administration.

Text books: Construction Cost Keeping and Management—Gillette and Dana. Principles of Industrial Organization—Kimball. Principles of Industrial Management—Allcut.

129. Plant Management. G. A. Guess.

Department 8, IV Year; 1 hr. per week, second term.

A course of twelve lectures dealing with some phases of labour, plant organization, smelter contracts and markets.

130. Industrial Management. E. A. Allcut.

Departments 3, 6, 7 and 8a, IV Year; 1 lecture per week, both terms.

This course includes a study of industrial organization, location, arrangement, construction and equipment of industrial plants for

efficiency and economy, process routing, scheduling work, reports, methods of superintending, employment, systems of compensating labour and systems of distributing indirect expenses.

Text book: Principles of Industrial Management—Allcut.

131. Municipal Administration. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. per week, second term.

A lecture course dealing with municipal government, assessment and taxation, municipal finance, public utilities, expropriation, annexation problems, town planning, local improvement and other laws relating to municipalities.

133. Public Speaking. F. H. Kirkpatrick.

Department 1, II Year, 1 hr. per week, second term.

Department 4, III Year; 1 hr. per week, first term.

A course on the principles of public speaking and the means of expression, accompanied by practical application and training in actual speaking.

ELECTRICITY

135. Electricity. H. W. Price.

Departments 1, 2, 3, 5, 6, 7, 8, 8a and 9, I Year; 2 hrs. per week, both terms.

A course of lectures on basic principles relating to electric circuits, magnetic circuits, instruments and apparatus in general, distribution of electrical energy, etc., illustrated largely from commercial apparatus. The point of view of this work is quantitative rather than descriptive, for it is believed that men who can solve engineering problems are most likely to grasp underlying principles.

136. Electricity. V. G. Smith.

Departments 3, 5, 6, 7, 8 and 8a, II Year; 2hrs. per week, both terms.

A course of lectures on the general principles and calculation of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power and energy. The principles underlying commercial instruments are considered together with the methods of calibration.

Reference Books: Electrical Measurements—Laws. Electrical Measurements in Theory and Application—Smith. Electrical Measurements and Measuring Instruments—Golding.

137. Electrical Laboratory. V. G. Smith.

Departments 3, 6, 7, 8 and 8a, II Year; 3 hrs. per week, both terms.

Department 5, II Year; 3 hrs. per week, first term.

The more important methods of measurement of resistance, current, potential difference, inductance, and capacity are used, often under conditions such as occur in practice. The principles of

measurement are applied to other problems such as the location of line faults and the measurement of temperature rise by resistance changes. Methods of calibrating commercial instruments are also included.

138. Magnetism and Electricity. A. R. Zimmer.

Department 3, III Year; 1 hr. per week, both terms.

Departments 5 and 7, III Year; 2 hrs. per week, first term; 1 hr. per week, second term.

A course of lectures on theory of magnetism and magnetic circuits, theory of direct-current generators, motors, etc.

Reference Books: Electrical Engineering, Vol. I—Dawes. Electrical Circuits and Machinery, Vol. I—Morecroft and Hehre. Electricity and Magnetism for Engineers, Part I—Pender. Principles of D.C. Machines—Langsdorf. Direct-Current Machinery—Pender. Electrical Engineering—Christie. Elements of Electrical Engineering—Cook. D. C. Machinery—Kloeffler, Brenneman and Kerchner.

139. Alternating Current. A. R. Zimmer.

(a) Departments 3, 6, 8 and 8a, III Year; 1 hr. per week, both terms.

(b) Departments 5h and 5e, III Year; 1 hr. per week, both terms.

Departments 5c, 5s, 5g, 5i and 7, III Year; 1 hr. per week, first term; 2 hrs. per week, second term.

A first course of lectures on alternating current, covering principles of measurement and leading to the analytical and graphical treatment of the simpler problems relative to alternating-current circuits and machinery.

Reference Books: Electricity and Magnetism for Engineers, Part II—Pender. Electrical Engineering—Christie. Electrical Engineering, Vol. II—Dawes. Electrical Circuits and Machinery, Vol. II—Morecroft and Hehre. Alternating Current Electrical Engineering—Maccall. Alternating Current Electrical Engineering—Kemp. Elements of Electrical Engineering—Cook.

140. Electrical Laboratory. A. R. Zimmer, H. W. Price.

Department 3, III Year; 4½ hrs. per week first term, 3 hrs. per week second term.

Departments 5c, 5s, 5g, 5i and 7, III Year; 6 hrs. per week, both terms.

Departments 5h and 5e, III Year; 3 hrs. per week, both terms.

This laboratory course is intended to afford the student an opportunity to become familiar with principles involved in continuous-current shunt, series and compound-wound generators and motors; and, to some extent, alternating-current circuits and machinery. Other sections of the work deal with the magnetic properties of iron and steel, and study of iron losses in transformers and generators.

The course is arranged to stand in close relation to the lecture

courses in the subjects of magnetism and electricty and alternating current (courses 138 and 139) for III Year, and to certain design work (course 141).

141. Electrical Design. R. J. Brown.

Departments 5c and 7, III Year; 1 hr. per week, both terms.

This course of lectures deals with fundamental principles underlying the design of electrical apparatus and is arranged to prepare the student for Course 142.

142. Electrical Design and Problems Laboratory, R. J. Brown.

Department 7, III Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

In this course the student designs such electrical apparatus as coils, electro-magnets, direct current machines, reactors and transformers. Other allied electrical problems are also solved.

143. Electricity. A. R. Zimmer.

Departments 1, 2 and 9, II Year; 1 hr. per week, both terms.

A course of lectures dealing with fundamental calculations of alternating current circuits and various applications of interest to those who are not making electricity a major subject.

144. Electrical Laboratory. A. R. Zimmer, H. W. Price.

(*a*) Department 1, II Year; 3 hrs. per week, second term; Department 2, IV Year, 3 hrs. per week, first term.

(*b*) Departments 6 and 8a, III Year; 3 hrs. per week, second term.

(*c*) Department 8, III Year; 3 hrs. per week, both terms.

These courses are arranged to suit the requirements of the departments concerned. The experiments are planned with the idea of affording a general knowledge of circuits, power measurements, direct-current and alternating-current machinery and transmission of power.

Reference Books: Elements of Electrical Engineering—Cook.

145*a*. Applied Electricity. V. G. Smith.

Symbolic and Graphical Methods.

Departments 5c and 7, IV Year; 2 hrs. per week, both terms.

Complex quantities and their use in a.c. problems. Loci for current and voltage vectors for given limitations on circuit constants. Short line distribution circuit loci; approximate graphical theory of synchronous motor.

Reference Books: Principles of Alternating Currents—Lawrence. Alternating Current Circuits—Weinbach.

145*b*. Applied Electricity. V. G. Smith.

Wave Form and Transmission Line.

Departments 5c and 7, IV Year; 1 hr. per week, both terms.

Non-sinusoidal alternating current waves, analysis of waves, forms of symmetry, three phase limitations, elimination of undesired harmonics, heating of rotary converters; power, current, and voltage readings as influenced by wave form.

145*c*. Applied Electricity. H. W. Price.

Alternating Current Machinery and Measurements.

Department 7, IV Year; 2 hrs. per week, both terms.

Polyphase alternating-current measurements of power, reactive power, apparent power, finding the indications of meters from given wiring diagrams, constructing wiring diagrams to obtain required meter indications. Potential and current transformers. Meter indications with distorted wave forms. Power transformers. Properties of alternators; induction motors of squirrel cage and wound-rotor types; synchronous motors; regulators; current-limiting reactors; arresters; and other general apparatus.

146. Electrical Laboratory. A. R. Zimmer, H. W. Price.

Department 5c, IV Year; 6 hrs. per week, both terms; Department 7, IV Year; 20 hrs. per week, both terms; in connection with Course 145.

This laboratory course involves a thorough study of principles and properties of single-phase and polyphase circuits and apparatus. Both vector and analytical methods are applied to the solution of problems based on tests made on laboratory machines.

The work deals mainly with constant-voltage and constant-current transformers, single and polyphase alternators, synchronous motors, rotary converters, induction and single-phase commutating motors, transmission line, etc. The work does not consist only of factory tests, but is designed to lead the student to apply theory to practice as illustrated in the apparatus under test, with a view to an exact understanding of methods and an appreciation of limitations under many conditions. Free use is made of the oscillograph as a necessary device for "seeing" conditions under investigation. The best commercial measuring instruments are available.

Reference Books: Electrical Engineering—Christie. Experimental Electrical Engineering, Vols. I and II—Karapetoff. Principles of A.C. Machinery—Lawrence. A.C. Machinery—Bryant and Johnson.

147. Communication. B. de F. Bayly.

Departments 5c, 5s and 7c, IV Year, in connection with course 148; 2 hrs. per week, both terms.

Vacuum tubes and their application, audio and radio frequency principles and measurements as applied to communication networks and equipment.

Reference Book: Communication Engineering—Everett.

148. Communication Laboratory. B. de F. Bayly.

Departments 5c and 5s, IV Year; 6 hrs. per week, both terms.

Department 7c, IV Year; 9 hrs. per week, both terms, in connection with course 147.

The work in this laboratory covers the principles and the technique of measurements at audio and radio frequencies on communication networks and equipment, including vacuum tubes and their application, bridge circuits, radio receiver measurements and transmission lines.

Reference Books: Communication Engineering—Everett. Communication Networks—Guillemin. Alternating Current Bridge Methods—Hague. High Frequency Measurements—Hund.

149. Acoustics. B. de F. Bayly.

Departments 5c, 5s and 7c, IV Year; 1 hr. per week, first term.

The principles of recording, transmission, and reproduction of sound in connection with electrical systems. Mechanical vibrating systems; microphones; loud speakers; causes of distortion; principles of hearing; reverberation.

Reference Books: Elements of Engineering Acoustics—Hughes. A Text Book of Sound—Wood. Acoustics—Stewart and Lindsay.

150. Thermionic Tubes. B. de F. Bayly.

Departments 5c, 5s, 5g and 5i, III Year; 1 hr. lecture per week, both terms, 3 hrs. laboratory per week, second term.

The basic principles of operation and construction of thermionic tubes of both the high vacuum and gaseous types.

151. Applications of Thermionic Tubes. B. de F. Bayly.

Department 5i, IV Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

The various fundamental circuits using thermionic tubes are given, including their applications.

152. Operational Calculus. V. G. Smith.

Departments 5c, 5s, 5e and 5i, IV Year; 2 hrs. per week, both terms.

Operational methods before Heaviside. Operators of electric circuits. Series expansions. Useful rules concerning shifting and transfer operations, differentiation and integration with respect to parameters. The Heaviside Expansion Theorem. Duhamel's theorem and Carson's integral. Campbell and Foster's mates and other tables. Evaluation by contour integration. Borel's theorem.

Reference books: Electromagnetic Theory—Heaviside. Operational Circuit Analysis—Bush. Electric Circuit Theory and the Operational Calculus—Carson. Heaviside's Operational Calculus—Berg. Fourier Integrals for Practical Applications—Campbell and Foster.

153. Electromagnetic Theory. V. G. Smith.

Departments 5c, 5s, and 5g, IV Year; 2 hrs. per week, both terms.

The principles of electromagnetism. Magnetic fields from currents in the neighbourhood of feromagnetic bodies. Electromagnetic waves guided by wires, their attenuation and reflection. Skin effects. Plane waves in space, their reflection and refraction. Cylindrical and spherical waves. Radiation from antennas.

Reference books: Electromagnetic Theory—Heaviside. Electricity and Magnetism—Jeans. Electro-Magnetic Problems in Electrical Engineering—Hague. Classical Electricity and Magnetism—Abraham-Bocker.

DESCRIPTIVE GEOMETRY, ENGINEERING PROBLEMS AND DRAWING

DESCRIPTIVE GEOMETRY

160. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3, 5, 6, 7, 8, 8a and 9; 1 hr. per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solutions of problems relating to straight lines and planes.

161. Descriptive Geometry. J. R. Cockburn.

Department 4, I Year; 1 hr. per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solution of problems relating to straight lines and planes, special reference being made to the determination of shades and shadows.

162. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3, 5, 7, and 9, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of the work taken in the First Year with the following additions: problems relating to curved surfaces, principles of shades, shadows and perspective.

163. Descriptive Geometry. J. R. Cockburn.

Department 4, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of the work taken in the First Year with the addition of problems relating to curved surfaces, shades, shadows and perspective.

164. Descriptive Geometry. J. R. Cockburn.

Department 1, III Year; 1 hr. per week, first term.

This course of lectures deals with spherical projections, the principles of mapmaking, and the graphical solution of spherical triangles.

ENGINEERING PROBLEMS AND DRAWING

These courses consist primarily in the solving of problems by the student at his drafting table under the personal guidance of an instructor. The problems are intended to supplement certain lecture courses. The problems in the First and Second years deal with the fundamental engineering studies—Mathematics, Applied Mechanics, Descriptive Geometry, the plotting of surveys that have been made by the students in the field, Theory of Mechanism and Steam Engines, while in the Third and Fourth Years, the problems deal mainly with design. During the hours devoted to mathematical problems, members of the staff in mathematics are present to assist.

166*a*. Engineering Problems and Drawing. A. Wardell.

Department 1, I Year; 10 hrs. per week, first term; 17 hrs. per week, second term.

Drawing and lettering. Plotting of original surveys. Problems in Descriptive Geometry. Graphical and analytical solutions of problems in Applied Mechanics. Problems in Mathematics (Analytical Geometry and Calculus).

166*b*. Engineering Problems and Drawing. A. Wardell.

Departments 2 and 9, I Year; 9 hrs. per week, first term; 12 hrs. per week, second term.

A course similar to 166a.

166*c*. Engineering Problems and Drawing. A. Wardell.

Department 3, I Year; 9 hrs. per week, first term; 15 hrs. per week, second term.

A course similar to 166a.

166*d*. Engineering Problems and Drawing. A. Wardell.

Department 4, I Year; 4 hrs. per week; both terms.

An elementary course in drawing and lettering. The solving of a few problems in Descriptive Geometry, Applied Mechanics and Mathematics.

166*e*. Engineering Problems and Drawing. A. Wardell.

Department 5, I Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

Drawing and lettering. Problems in Descriptive Geometry. Graphical and analytical solutions of problems in Applied Mechanics. Problems in Mathematics (Analytical Geometry and Calculus).

166*f*. Engineering Problems and Drawing. A. Wardell.

Department 6, I Year; 3 hrs. per week; both terms.

An elementary course in drawing and lettering. The solving of a few problems in Descriptive Geometry, Applied Mechanics and Mathematics.

166*g*. Engineering Problems and Drawing. A. Wardell.

Department 7, I Year; 12 hrs. per week, first term, 18 hrs. per week, second term.

A course similar to 166a, but containing more mathematical problems.

166*h*. Engineering Problems and Drawing. A. Wardell.

Department 8, I Year; 13 hrs. per week, first term; 19 hrs. per week, second term.

A course similar to 166a.

166*ha*. Engineering Problems and Drawing. A. Wardell.

Department 8a, I Year; 3 hrs. per week, both terms.

A course similar to 166f.

167*a*. Engineering Problems and Drawing. J. J. Spence.

Department 1, II Year; 5 hrs. per week, first term; 10 hrs. per week, second term.

Problems in Descriptive Geometry—intersection of curved surfaces. Plotting of original surveys. Problems in Mechanics of Materials—properties of sections, designs of simple members. Problems in Mathematics (Calculus).

167*b*. Engineering Problems and Drawing. J. J. Spence.

Departments 2 and 9, II Year; 3 hrs. per week, first term; 10 hrs. per week, second term.

Problems in Descriptive Geometry, Mechanics of Materials, Flow sheets.

167*c*. Engineering Problems and Drawing. J. J. Spence.

Department 3, II Year; 15 hrs. per week, first term; 8 hrs. per week, second term.

Problems in Descriptive Geometry—intersection of curved surfaces. Problems in Mechanics of Materials, Theory of Mechanism, Steam Engines, Electricity. Problems in Mathematics (Calculus).

167*f*. Engineering Problems and Drawing. J. J. Spence.

Department 6, II Year; 7 hrs. per week, first term; 3 hrs. per week, second term.

Problems in Mechanics of Materials, Electricity and Mathematics.

167*g*. Engineering Problems and Drawing. J. J. Spence.

Department 7, II Year; 10 hrs. per week, first term; 15 hrs. per week, second term.

A course similar to 167c, but with more problems in Mathematics.

167*h*. Engineering Problems and Drawing. J. J. Spence.

Department 8, II Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

Problems in Mechanics of Materials, Electricity, and Descriptive Geometry.

167*ha*. Engineering Problems and Drawing. J. J. Spence.
Department 8a, II Year; 7 hrs. per week, first term; 3 hrs. per week, second term.
A course similar to 167f.

168*a*. Engineering Problems and Drawing. W. B. Dunbar.
Department 1, III Year; 13 hrs. per week, first term; 14 hrs. per week, second term.
Problems in design of steel structures, riveted and welded connections, tension members, beams, columns, highway and railway trusses. Problems in Descriptive Geometry to illustrate the theory of map making.

168*b*. Engineering Problems and Drawing. W. B. Dunbar.
Department 2, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.
Problems in design of steel structures, riveted and welded connections, tension members, beams, columns.

168*c*. Engineering Problems and Drawing. W. B. Dunbar.
Department 3, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.
A course similar to 166b.

168*ee*. Engineering Problems and Drawing. W. B. Dunbar.
Department 5e, III Year; 6 hrs. per week, first term; 9 hrs. per week, second term.
A course similar to 166b.

168*eh*. Engineering Problems and Drawing. W. B. Dunbar.
Department 5h, III Year; 3 hrs. per week; both terms.
A course similar to 168b, but less extensive.

168*f*. Engineering Problems and Drawing. W. B. Dunbar.
Department 6, III Year; 3 hrs. per week; both terms.
A course similar to 168b, but less extensive.

168*h*. Engineering Problems and Drawing. W. B. Dunbar.
Department 8, III Year; 3 hrs. per week; first term.
Plotting of flow sheets.

168*ha*. Engineering Problems and Drawing. W. B. Dunbar.
Department 8a, III Year; 3 hrs. per week; both terms.
A course similar to 168f.

178*a*. Engineering Problems and Drawing. W. J. Smither.
Departments $1a_1$, $1a_2$, $1a_3$, IV Year; 15 hrs. per week average; both terms.
A course dealing with advanced problems on the design of steel and reinforced concrete structures—floor panels, mill buildings, tanks, reservoirs, towers, truss and arch bridges, foundations, dams, retaining walls, wind bracing. Problems on moment distribution in rigid frames, influence lines and deflection of trusses.

178*a2*. Engineering Problems and Drawing. W. J. Smither.
Department $1a_2$, IV Year.
A course dealing with problems in the design of railway structures 269a.

178*c*. Engineering Problems and Drawing. W. J. Smither.
Department 3, IV Year; 3 hrs. per week, first term.
A course dealing with problems on the determination of stresses in and the design of mill buildings, flume trestles, crane runways, and floor panels for machinery loading.

178*ha*. Plant Design. W. J. Smither, R. J. Montgomery.
Department 8a, IV Year; 3 hrs. per week, first term.
A course devoted to the original design of ceramic plants, driers, kilns, etc.

179. Engineering Problems and Drawing. W. J. Smither.
Department $1a_1$, IV Year; 3 hrs. per week, second term.
Problems on the design of water distribution and sewer systems as well as water and sewage treatment works. (Course 267a).

APPLIED PHYSICS

185*a*. Applied Physics. V. L. Henderson.
Departments 3 and 7, I Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.
A course of lectures with laboratory work on the production and distribution of light, photometry and illumination, optics and optical instruments.

185*b*. Optics. K. B. Jackson.
Department 6, I Year; 1 hr. lecture per week, both terms, 3 hrs. laboratory per week, first term.
A course of lectures with laboratory work on light, geometrical and physical optics, and optical instruments.

Optics, see Course 312.

186. Applied Physics Laboratory. C. A. Booth.
Department 6, II Year; 1 hr. laboratory per week, second term.
A short laboratory course supplementing 185b in Optics.

187. Applied Physics. C. A. Booth.
Department 1, I Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.
A course of lectures and laboratory work on optics and optical instruments, the projection of light and its applications in marine and railway signalling, flood lighting, etc.

188. Photography. K. B. Jackson.

Department 4, II Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the principles of photography, photographic equipment, materials, and processes, with special reference to architectural photography and an outline of the photo-mechanical processes.

188*a*. Photography Applied to Research. K. B. Jackson.

Senior and graduate students; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the principles of photography, the choice and use of equipment for special purposes, the photometry of projection, sensitometry and the correct use of photographic materials and processes.

189. Photographic Surveying. K. B. Jackson, W. M. Treadgold.

Department $1a_3$, IV Year; 3 hrs. lectures per week, first term; 2 hrs. lectures per week, second term; 3 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the photographic processes involved, the calibration of surveying cameras, the stereoscopic examination of photographs, and methods of plotting in ground and aerial photographic surveying.

189*a*. Photographic Surveying. K. B. Jackson, W. M. Treadgold.

Department 1b, IV Year; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

A short course of lectures with laboratory work on the subject matter of course 189.

190. Light and Sound. V. L. Henderson.

Department 4, III Year; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

An elementary course of lectures with laboratory work on the production, distribution, and measurement of light, sound, and electricity in preparation for course 191.

191. Acoustics and Illumination Design. V. L. Henderson.

Department 4, IV Year; 1 hr. lecture, 1 hr. laboratory per week, both terms.

A course of lectures with laboratory work on architectural acoustics, the properties and uses of acoustical materials, and the design of lighting installations for public and private buildings.

191*a*. Architectural Acoustics. K. B. Jackson, V. L. Henderson.

Department 5i, IV Year; 2 hrs. lecture, 6 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the design of buildings for good acoustics, on the calculation and measurement of the acoustical properties of buildings and materials, and on the treatment of buildings to improve their acoustical properties and to control the nuisance of noise.

192. Photometry. K. B. Jackson.

Department 7i, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, first term; 1 hr. lecture, 3 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the production, distribution, and measurement of light and colour, the theory and application of visual and physical photometers, and the photometry of projection equipment.

192*a*. Illumination Design. K. B. Jackson, V. L. Henderson.

Department 7i, IV Year; 1 hr. lecture, 6 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the theory and design of lighting equipment and installations.

192*b*. Photometry and Illumination Design. K. B. Jackson, V. L. Henderson.

Department 5i, IV Year; 2 hrs. lecture, 6 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on measurements of luminous intensity, luminous flux, illumination, brightness, reflection, transmission, absorption, diffusion, and colour by visual and physical methods; and on the design and application of illuminating engineering equipment.

GEOLOGY

193. Field Work. E. S. Moore.

Departments 2 and 9, III Year; one week at the University Survey Camp preceding the opening of the first term.

194. Pleistocene Geology and Physiography. A. MacLean.

Departments 2 and 9, IV Year; 1 hr. per week, both terms.

Pleistocene Geology. Lectures on the formation and distribution of the drift deposits of North America, with brief references to other regions. Glacial, interglacial, and postglacial beds are described, changes of climate are discussed with their probable causes, and the economic features of the clays, sands, and gravels are considered.

Physiography. A course of lectures on the surface forms of the earth, and on the geological factors that have produced them. The broad features of the earth, its plains, tablelands, hills, valleys, mountains, oceans, rivers, and lakes are discussed in a general way; methods of topographical surveying and mapping are referred to, and the chief physiographic areas of Canada are described.

Works of reference: Ice Ages, Recent and Ancient—Coleman. Physiography—Salisbury.

195. Elementary Geology. J. Satterly.

Departments 1, 2 and 9, II Year; Department 5g, IV Year; 2 hrs. per week, second term.

This course deals chiefly with historical geology with special reference to Canadian formations.

Works of reference: Introduction to Geology—Scott. Elementary Geology—Coleman and Parks.

195*a*. Stratigraphic Geology. V. J. Okulitch.

Department 9, III Year; 5 hrs. per week, both terms.

Principles of sedimentation, divisions of the geological column, identification of fossils and their use in determining the age of rocks.

Text book: Historical Geology—Schuchert and Dunbar.

196. Geology and Ore Deposits. J. Satterly.

Departments 8 and 8a, II Year; 2 hrs. per week, both terms.

Lectures and laboratory work on historical, structural, and economic geology, designed to familiarize the student with the more important principles, facts, and terms of general geology.

Works of reference: As in course 195.

197. Engineering Geology. A. MacLean.

Department 1, III Year; 1 hr. per week, both terms.

This course deals with the application to engineering of dynamic, structural, and economic geology.

Works of reference: Engineering Geology—Ries and Watson.

198. Dynamic and Structural Geology. A. MacLean.

Departments 2 and 9, II Year; Department 5g, IV Year; 1 hr. per week, first term.

Lectures on geological forces and their effects. Particular attention is given to those aspects of the subject that apply in mining.

Works of reference: Geology—Emmons, Thiel, Stauffer and Allison.

198*a*. Structural Geology Laboratory. G. B. Langford.

Department 9, III Year; 6 hrs. per week, first term and 3 hrs. per week, second term.

Projection to scale and in perspective of ore bodies and structural features, and preparation of models of geological features.

199. Precambrian Geology. E. S. Moore.

Departments 2, 5g and 9, IV Year; 2 hrs. per week, first term.

Lectures on the Precambrian formations of Canada—their rocks, distribution, relationships, and economic features. Briefer accounts are given of similar formations in the United States and elsewhere.

Works of reference: Reports of the Geological Survey of Canada and of the Ontario Department of Mines. Reports of the United States Geological Survey.

199*a*. Precambrian and Economic Geology. G. B. Langford.

Department 9, IV Year; 5 hrs. per week, both terms.

Detailed study of the Precambrian and economic geology of Canadian and foreign mining camps.

200. Mining Geology. E. S. Moore.

Departments 2, 5g and 9, IV Year; 2 hrs. per week, second term.

A course of lectures on geological problems associated with mining, typical mining regions in Canada, the United States, and elsewhere being discussed from the geological side.

Works of reference: Mineral Industry. Geology Applied to Mining—Spurr; and the works mentioned under course 199.

201. Geological Excursions. A. MacLean.

Departments 2 and 9, IV Year.

During October weekly trips will be made to points of interest near Toronto.

202. Economic Geology. E. S. Moore.

Departments 2 and 9, III Year; Department 5g, IV Year.

(*a*) Ore Deposits: 1 hr. per week, both terms.

Discussion of the origin and classification of ore deposits, the mode of occurrence of the chief ores, and statistics of production. Special attention is given to the metals mined in Canada.

(*b*) Economic Geology of the Non-metals: 2 hrs. per week, second term.

Lectures on the origin and mode of occurrence of the valuable non-metallic substances—coal, oil, building stone, gypsum, cement materials, etc.

Works of reference: Economic Geology—Ries. General Economic Geology—Emmons. Coal—Moore. Practical Oil Geology—Hager. Mineral Resources of Canada—Moore. Introduction to the Study of Ore Deposits—Hatch.

203. Economic Geology. E. S. Moore.

Department 2, III Year; 2 hrs. per week, second term.

Laboratory work on ores, manner of occurrence, vein structure, etc., also the examination and construction of geological maps and sections of typical mining regions.

203*a*. Economic Geology. E. S. Moore.

Department 9, III Year; Department 5g, IV Year; 3 hrs. per week, both terms.

Laboratory work on ores, geological features of mining areas, interpretation of drill logs, geological maps, and structure sanctions.

203*b*. Location of Mineral Deposits. G. B. Langford.

Departments 5g and 9, IV Year; 2 hrs. per week, second term.

Geological features and principles involved in the application of geophysical methods in the search for mineral deposits, and the interpretation of the structure of the earth's crust.

203*c*. Economic Geology. J. Satterly.

Department 8a, IV Year; 2 hrs. per week, second term.

The nature, occurrence and origin of non-metallic deposits, excepting fuels.

203*d*. Economic Geology of Canada. J. Satterly.

Department 9, IV Year; 2 hrs. per week, first term.

A survey of the mineral deposits of the country with special reference to their relations to physiography, general geology and major structural features.

204. Building Stones. E. S. Moore.

Department 4, IV Year; 1 hr. per week, first term.

Lectures and laboratory work on decorative and structural stones used in building; their properties, sources, extraction, and preparation for use in buildings.

204*a*. Thesis.

Department 9, IV Year; 6 hrs. per week, both terms.

The thesis will consist of a report on an investigation made by the student. It is intended to test his ability to make an independent field or laboratory study of some geological problem. The problem chosen must be approved by the head of the Department of Geology and plans for the thesis completed not later than November 1 of the student's Fourth Year.

HYDROSTATICS AND HYDRAULICS

205. Hydraulics. R. W. Angus.

Departments 1, 2, 3, 6 and 7, III Year and Department 8a, IV Year; 2 hrs. per week, both terms.

This is a course of lectures in hydraulics devoted to the development and discussion of formulae relating to the flow of water in pipes, the measurement of discharge by various methods, such as orifices and weirs, the conditions of flow obtaining in open channels, artificial and natural, and in pipes flowing partially full, together with other kindred subjects.

The object of this course is to provide the student with a good working knowledge of the fundamental principles of hydraulics, such as are useful in practical work, and are necessary to the intelligent investigation of more advanced problems, such as the design of water supply, sewerage and irrigation systems, and water power plants.

Text book: Hydraulics for Engineers—Angus.

206. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Departments 1, 2, 3 and 7, III Year; one 3 hr. period per week, second term.

Department 6, III Year and Department 8a, IV Year; average 1½ hrs. per week, second term.

The work in this course is intended to illustrate the lecture course given in hydraulics and to give the student some working acquaintance with the formulae derived. Experiments are made to determine the coefficients for orifices of the various types used in practice and for weirs. The results of these experiments are used in measuring the discharge in subsequent experiments on meters and for the determination of hydraulic resistances in various cases of flow in pipes. The complete course illustrates very fully the application of the course of lectures to actual cases.

207. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 1 lecture per week, both terms.

A course of lectures dealing with the various problems of unsteady flow such as occur in power plants, penstocks, etc. Much of the work is done by the process of arithmetic integration, and the lecture work is supplemented by problems solved by the students in the work rooms, the time for which is included in course 209. Surges, water hammer, stream flow data, etc., are discussed.

The problems of collection of water for power purposes, use of the mass curve, rainfall and evaporation, turbine governing, etc., are also treated as far as possible.

Text book: Hydraulics for Engineers—Angus.

208. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 2 lectures per week, both terms.

The most important question considered and to which most of the lectures are devoted is the theory of turbines and centrifugal pumps, the effect of the design on the speed, discharge and efficiency being fully taken up. The course includes the selection of turbines and pumps for given service; intakes, draft tubes and all matters connected with hydraulic power plants.

Text book: Hydraulics for Engineers—Angus.

209. Hydraulics. R. W. Angus, R. Taylor.

Department 7h, IV Year; 9 hrs. per week, first term, 6 hrs. per week, second term; Department 3, average of 7½ hrs. per week in 3 and 2 hr. periods.

A laboratory course devoted to experimental work on turbines of various types and centrifugal and turbine pumps and other similar devices. This experimental work is arranged to illustrate the lectures on turbine and pump design. The experiments are made on hydraulic models and on two large turbine pumps used in the laboratory supply, as well as on apparatus specially designed for instruction. Various methods of measuring water-power and the efficiency of machines are also given. A list of the equipment now available and which is used in this course, is given in Section XII.

210. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Department 8, IV Year; 3 hrs. per week, second term.

A laboratory course of experiments on orifices, weirs, meters, etc. See course 206.

211. Hydraulics. R. W. Angus, R. Taylor.

Department 1a, IV Year; 1 hr. lecture per week, both terms.

Laboratory course of 1 three hr. period per week, first term.

The course of lectures deals with general hydraulic problems such as surges in pipe lines, water hammer, flow in open channels and backwater, mass curves, a general discussion of pumps and turbines.

The laboratory course consists of class room instruction and experiments bearing on the lectures.

Text book: Hydraulics for Engineers—Angus.

212. Hydrostatics. R. W. Angus.

Departments 3, 6, 7 and 8a, II Year; 1 hr. per week, second term.

Fluid pressure and its application in the design of engineering structures. Forces acting on the bottoms and ends of tanks; pressures on pipes, gates and walls; stability of dams; laws governing the equilibrium of floating bodies.

213. Properties of Fluids. G. R. Lord.

Department 3, I Year; 1 hr. per week, both terms.

This course of lectures is intended to prepare the student for work in hydraulics, thermodynamics and machine design.

214. Properties of Fluids. G. R. Lord.

Department 3, II Year; 1 hr. per week, both terms.

This lecture course is a continuation of Course 213.

THERMODYNAMICS AND HEAT ENGINES

216. Steam and Heat Engines. E. A. Allcut.

Departments 3 and 7, II Year; 1 lecture per week, both terms.

Departments 2, 8 and 9, II Year; 1 lecture per week, first term.

A course of lectures dealing with the history and development of the steam engine with special reference to the theory and design of valves and valve operating mechanisms. The principles of heat engines and the various forms of heat engine are also discussed briefly.

217. Thermodynamics. E. A. Allcut.

Departments 3, 6, 7 and 8a, III Year; 2 lectures per week, both terms.

In this lecture course the laws of heat are used to develop the characteristic equation for a perfect gas and the use of thermal lines on the pressure-volume diagram. The properties of Carnot's cycle

are then considered, followed by application of these principles to the hot-air engine, internal combustion engine and air compressor. A consideration of the properties of vapours and their application to the steam engine cycle and refrigeration concludes the course.

218. Heat Engines. R. C. Wiren.

(*a*) Departments 3, 7 and 8, III Year; 1 lecture per week, both terms.

This course of lectures is intended to supplement the general lecture course in Thermodynamics by showing the practical application of the laws discussed therein. The laws of combustion, their application to the boiler practice and the generation and uses of steam are the principal points considered.

(*b*) Department 3, III Year; 1 lecture per week, both terms.

These lectures are a further development of the internal combustion work commenced in the Second Year, the influence of thermodynamic considerations on the design of heat engines, and problems in heat transfer, being discussed. The laws of heat transmission and their influence on Heating and Ventilation problems are also considered.

219. Thermodynamics and Mechanical Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, III Year; 1 three hr. period per week, both terms.

Department 7, III Year; 3 hrs. per week, first term.

Time to be in three-hr. periods in all cases.

This laboratory course is designed to assist in a clearer understanding of thermodynamics, machine design and mechanics of machinery. The work in thermodynamics consists in the setting of slide valves, indicating engines measuring the brake horse-power, simple engine and boiler tests and the testing of gas and gasoline engines under various conditions. The mechanical laboratory work deals with the efficiency of belts as well as of several machines of simple construction. An examination of lubricating oils is also made by means of well-known methods. Experiments are also made on the balancing of reciprocating and rotating masses.

220. Thermodynamics. E. A. Allcut.

Departments 3 and 7t, IV Year; 2 hrs. per week, both terms.

This is a continuation of course 217, the general thermodynamic theory being studied from the conception of the thermodynamic surface. The theory of the flow of gases and vapours through orifices, nozzles and pipes is then discussed, and its application to the various forms of turbine is outlined. Thermodynamic losses and their causes, as exemplified by the steam power plant, are studied in detail.

221. Heat Engines. E. A. Allcut.

Departments 3 and 7t, IV Year; 1 hr. per week, both terms.

The first part of the course deals with refrigeration and includes studies on reversed heat engines, as exemplified by air, vapour compression and absorption machines. The various cycles employed and the properties of refrigerating vapours are studied in detail. Applications of refrigeration, as in air conditioning and industrial processes, are also described.

The second part is devoted to internal combustion and begins with a discussion of the constant volume and constant pressure cycles together with their associated losses. The properties of the various liquid fuels and their influence on combustion in a cylinder are also studied. The course concludes with a consideration of high speed compression ignition engines and the problems associated therewith.

222. Thermodynamics. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, IV Year; average 7½ hrs. per week, and 7t, IV Year, 9 hrs. per week, first term, 6 hrs. per week, second term.

The work in this year is a continuation and extension of the work covered in the Third Year laboratory course. Careful tests are made of heaters and of engines of various types, such as simple, tandem and cross-compound steam engines; steam turbine; refrigerating machine; injectors and steam pumps, etc.; and an application is made of Hirn's analysis and the entropy diagram to the results obtained. A complete set of experiments is made on each machine and the result plotted so as to show clearly to the student the effect of various alterations in the adjustment of the engine on the resulting efficiency.

Several modern gas and gasoline engines give ample opportunity for the study of this type of engine, and facilities are provided for sampling the gas supply and exhaust.

Two experimental stacks and three boilers enable results to be obtained on boiler efficiency and chimney draft.

223. Thermodynamics. E. A. Allcut.

Departments 1 and 8, III Year; 1 lecture per week, both terms.

Department 2, IV Year; 1 lecture per week, both terms.

The general principles of thermodynamics, the properties of a perfect gas and their application to the Carnot cycle are first studied. This is followed by a consideration of the air compressor cycle, some details of air compressor operation and the theory of the flow of air through pipes and orifices. The properties of vapours and the principles of steam engine operation are also discussed.

224. Thermodynamics Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 1, III Year; eight 3 hr. periods, second term.

Departments 6 and 8a, III Year; average $1\frac{1}{2}$ hours per week, second term.

Department 8, III Year; 3 hrs. per week, second term.

Department 2, IV Year; 3 hrs. per week, first term.

A course of experiments with steam and gas engines, compressed air, etc.

225. Thermodynamics. E. A. Allcut, R. C. Wiren.

Department 5h, III Year; 2 hrs. lecture per week, both terms, and 3 hrs. per week in the laboratory, second term.

The lecture course consists of a study of thermodynamic cycles and their application to engines, compressors, turbines and refrigerating machines. The properties and the limitations of the various working fluids are also considered in relation to their use in such machines.

The laboratory work comprises a series of experiments designed to show how the principles given in the lecture courses are applied in practice.

226. Aircraft Engines. E. A. Allcut.

Department 5h, IV Year; 1 hr. per week, both terms.

The lectures in the first term will consist partly of descriptions of the various types of aircraft engines and will include a consideration of the laws of heat transfer and their application to cooling problems in aircraft engine cylinders. Those in the second term will be identical with Course 221 and will be taken in conjunction with IV Year, Departments 3 and 7t.

MACHINERY

227*a*. Shop Work. W. G. McIntosh.

Department 3, III Year; 600 hrs.

The student is required to obtain this practical experience in industry, and preferably in the foundry, the forge shop and the machine shop. Such work assists the student in his understanding of the lecture and laboratory work throughout his entire course in Mechanical Engineering, and particularly the design work in his Third and Fourth Years.

Instruction regarding the type of work which is acceptable, and any special requirements, will be given to the student during his Second Year.

227*b*. Shop work. W. G. McIntosh.

Department 3, IV Year; the balance of 1200 hours.

This is a continuation of the work outlined in the Third Year course 227a.

Instruction regarding the type of work which is acceptable, and any special requirements, will be given to the student during his Third Year.

228. Machines and Processes. W. G. McIntosh.

Department 3, I Year; 1 hr. per week, both terms.

In this lecture course the various machines and processes used in shops are treated in a simple manner, so as to acquaint the student with the nautre of such work. The course is largely descriptive.

Text books: Factory Equipment—Roe and Lytle. Metal Castings—Campbell.

228*a*. Machines and Processes. W. G. McIntosh.

Department 3, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of Course 228 in the First Year, but dealing more particularly with materials of design and production methods. In addition, standards, tolerances, limits, fits and mechanical drafting room practice will be explained.

Text books: Factory Equipment—Roe and Lytle. Machine Drawing—Tozer and Rising. Drawings and Drafting Room Practice.

229. Machinery. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 1, III Year; 1 lecture per week, both terms, and 1 three hour drafting board period per week, second term.

This course of lectures and work on the drafting board is intended to give the civil engineer some acquaintance with the machinery used in bridges, machinery for conveying and moving materials, shovels, pumping, etc. The drafting problems will be used to illustrate the lecture course.

Text book: Machine Design—Berard and Waters.

230. Theory of Mechanism. R. Taylor.

Departments 3 and 7, II Year; 2 hrs. lectures per week, both terms.

This course of lectures treats of the elementary construction of machines and of the motions of the various parts. Methods of determining linear and angular velocities, methods for the solution of elementary problems involving forces and methods for the determination of the mechanical efficiency of machines are discussed. Velocity diagrams, crank effort and torque diagrams are plotted. Cams, toothed gearing and various types and applications of trains of gearing are considered.

Text book: Theory of Machines—Angus.

231. Mechanics of Machinery. W. G. McIntosh.

Departments 3 and 7, III Year; 1 hr. per week, both terms.

This course is devoted to a consideration of accelerations in machines, acceleration and inertia forces and effects, balancing of machines, kinetic energy of machines, speed fluctuations, proper weight of fly-wheel.

Applications of the methods described are made to various machines, including engines, machine tools, link motions, etc., and the lecture work is followed up by the solution of numerous examples in the drafting room.

The methods of analysis employed are those developed in course 230.

Text book: Theory of Machines—Angus.

232. Elementary Machine Design. W. G. McIntosh.

Departments 6, 7 and 8a, II Year; 1 hr. per week, both terms.

This is a preparatory course intended to familiarize the student with the different shop methods and processes, casting, forging, machining, etc., used in the production of machine parts, to enable him to make proper provision in the design of such parts to facilitate their production.

In addition, the various standards, machine and pipe threads, tapers, pipe fittings, etc., are described and mechanical drafting room practice explained. Tolerances, limits, fits and gauges are discussed.

Text book: Factory Equipment—Roe and Lytle. Drawings and Drafting Room Practice.

233. Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Departments 3 and 7, III Year; 2 lectures per week, both terms.

The design work averages 8 hrs. per week for Department 3, and 3 hrs. per week for Department 7, the periods to be of not less than 2 hrs. duration.

The lectures in this course deal with the design of various machine elements, including screw threads for fastening and power transmission, shafting, bearings (journal, thrust, ball and roller), belts, pulleys, spur gears, fly-wheels, keys, clutches, springs, etc.

The problems worked out in the drafting room are planned to include the design of all of the above and with a view to developing the student's judgment and sense of proportion in design.

Text book: Design of Machine Elements—Faires.

234. Machine Design—W. G. McIntosh, G. H. Hally, T. C. Graham.

Departments 2, 6, 8 and 8*a*, IV Year; 1 lecture per week, both terms.

The design work occupies 3 hrs. per week for the second term only.

The lectures in this course deal with the design of various machine

elements, particularly those likely to be met with in chemical and metallurgical plants, and in mining work.

The problems worked out in the drafting room are designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical and metallurgical apparatus, and mine machinery.

Text book: Machine Design—Berard and Waters.

234*a*. Elementary Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 5, II Year; 1 lecture per week, both terms, and one three hour drafting board period per week, both terms.

This course of lectures and work on the drafting board is intended to give some acquaintance with the selection of materials and their use in the design and construction of machinery. Machine parts are analysed as to suitable materials, production methods, the nature and magnitude of the stresses encountered, the standard practice in detailing such parts.

Text book: Machine Design—Berard and Waters.

235. Advanced Machine Design. W. G. McIntosh, G. H. Hally, T. C. Graham.

Department 3, IV Year; 2 lectures per week, both terms.

The design work averages 7 hrs. per week, the periods to be of not less than 2 hrs. duration.

The lectures of this course deal with the design of machine frames, hooks, hoisting equipment, crank shafts, gears of various kinds (herring-bone, bevel, screw) worm gearing, clutches and brakes.

The work in the drafting room is devoted to the design of complete machines with the object of giving the student practice not only in the design of various details, but also in working the various elements into a machine of smooth and harmonious design. The machines chosen as examples for design involve as many new machine elements as possible in order to broaden the training of the student.

Text book: Design of Machine Elements—Faires.

MATHEMATICS

See Advanced Mathematics, p. 122.

236. Calculus. D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell, S. A. Jennings, J. C. Mark.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 2 hrs. per week, both terms.

Derivation of the fundamental formulae of the differential and integral calculus, with early applications to simple problems concerning graphs, areas, volumes, lengths, centres of gravity, and moments of inertia. In addition problems are worked out in the drafting room as outlined in courses 166a, 166b, 166c, 166d, 166e, 166f, 166g and 166h.

237. Calculus. I. R. Pounder, D. A. F. Robinson, Miss M. E. G. Waddell, S. A. Jennings.

Departments 1, 3, 6 and 7, II Year; 2 hrs. per week, both terms.

Continuation of course 236. The elementary theory reviewed and extended. Special attention to applications with problems in engineering mostly in view. Introduction to the study of simple differential equations. In addition problems are worked out in the drafting room as outlined in courses 167a, 167b, 167c, 167f, 167g and 167h.

238. Analytical Geometry. D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell, S. A. Jennings, J. C. Mark.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 1 hr. per week, first term, 2 hrs. per week, second term.

The course in Elementary Analytical Geometry covers the more familiar propositions in connection with the straight line, circle, parabola, ellipse and hyperbola. The subject is treated so as to illustrate the general methods of analytical geometry. In addition problems are worked out in the drafting room as outlined in courses 166a, 166b, 166c, 166d, 166e, 166f, 166g and 166h.

239. Spherical Trigonometry. J. W. Melson.

Department 1, II Year; 1 hr. per week, first term.

A course of lectures includes the derivation of formulae and their application to the solution of triangles and to practical problems.

Text book: Spherical Trigonometry—Todhunter and Leatham.

240. Method of Least Squares. J. W. Melson.

Department 1, II Year; 1 hr. per week, second term.

The course of lectures includes: The general principles of probability, the law of error, direct measurements of equal and different weights; mean square and probable errors; indirect measurements; conditioned observations; applications to empirical constants and formulae, etc.

Text book: Least Squares—Merriman.

METALLURGY

241. Elementary Metallurgy. G. A. Guess.

Departments 2, 3, 6, 8, 8a and 9, II Year; 1 hr. per week, second term.

A course of about 12 lectures on furnace metallurgy and present practice, with special reference to iron and steel.

242. Fuels and Combustion. G. A. Guess.

Department 8, II Year; 1 hr. per week, both terms.

A lecture course dealing with fuels, their use, preparation, caloric value and combustion.

243. Metallurgy. G. A. Guess.

Departments 2, 6, 8a and 9, III Year; 1 hr. per week, both terms.

Fuels, temperature of combustion, specific heat, conductivity and problems thereon; chimneys, furnaces, refractories, outline of furnace metallurgy and hydro-metallurgy.

244. Physical Metallurgy. J. A. Newcombe.

Departments, 3, 5c, 5s, 5g, 5h, 5e, 6, 7 and 8a, III Year; 2 hrs. per week, second term.

A lecture course on general Physical Metallurgy.

245. Metallurgy. G. A. Guess, J. E. Toomer.

Department 8, III Year; 2 hrs. per week, first term; 1 hr. per week, second term.

A lecture course on General Metallurgy accompanied by 3 hrs. laboratory per week, first term, and 6 continuous hrs. per week, second term.

246. Physical Metallurgy. J. A. Newcombe.

Department 8, III Year; 1 hr. per week, both terms.

Changes of phase and of state, pyrometry, preparation of alloys, miscibility of metals, binary, ternary and complex alloys, the use of the microscope, with 3 hrs. laboratory per week, first term.

247. Metallurgy. G. A. Guess, J. E. Toomer.

Departments 2 and 6m, IV Year; 1 hr. lecture per week, both terms; 6 continuous hrs. laboratory per week, second term.

General metallurgy and metallurgical problems.

248. Metallurgy Problems. G. A. Guess, J. E. Toomer.

Department 8, IV Year; 2 hrs. lecture and 4 hrs. laboratory per week, both terms.

Metallurgical book-keeping, balance sheets, thermal balance sheets, methods and processes.

249. Metallurgy. G. A. Guess.

Department 8, IV Year; 1 hr. per week, both terms.

Critical reading and discussion of papers and articles, describing metallurgical processes or dealing with plant arrangement and construction. Metallurgical flow sheets of typical plants.

250. Physical Metallurgy. J. A. Newcombe.

Departments 6m and 8, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

252. Physical Metallurgy. J. A. Newcombe.

Department 1, II Year; 1 hr. lecture per week, second term.

The physical properties of metals and alloys used in civil engineering practice.

253. Heat Treatment of Iron and Steel. J. A. Newcombe.

Department 3, IV Year; 1 lecture per week, both terms.

Heat treatment of iron and steel, case carburizing, case hardening and malleableizing.

CERAMICS AND NON-METALLIC MINERALS

254*a*. Non-Metallic Minerals. R. J. Montgomery.

Department 8a, III Year; 4 hrs. per week, first term; 2 hrs. per week, second term.

Lectures covering the industrial classification, properties, and utilization of non-metallic minerals. Ceramic plant practice is covered in some detail in the second term.

254*b*. Non-Metallic Minerals Laboratory. R. J. Montgomery.

Department 8a, III Year; 6 hrs. per week, first term; 9 hrs. per week, second term.

The physical properties and thermal characteristics of non-metallic minerals are studied from an industrial standpoint.

254*c*. Ceramics. R. J. Montgomery.

Department 8a, III Year; 2 hrs. per week, second term.

Lectures are given on the composition of clear and coloured glazes.

254*d*. Ceramic Calculations. J. E. Toomer.

Department 8a, IV Year; 1 hr. per week, first term.

Lectures and problems on calculations necessary for the compounding of ceramic bodies and glazes.

254*e*. Non-metallic Minerals Laboratory. J. E. Toomer.

Department 8a, IV Year; 6 hrs. per week, first term; 3 hrs. per week, second term.

Laboratory practice in the analysis of non-metallic minerals.

254*f*. Refractories and Ceramic Bodies. R. J. Montgomery.

Department 8a, IV Year; 2 hrs. per week, first term; 1 hr. per week, second term.

Lectures on the composition of bodies made using non-metallic minerals with special reference to refractories, whiteware, and porcelain.

254*g*. Glass and Enamels. R. J. Montgomery.

Department 8a, IV Year; 1 hr. per week, both terms.

Lectures on the composition and manufacture of glass and iron enamels.

254*h*. Non-Metallic Mineral Products. R. J. Montgomery.

Department 8a, IV Year; 1 hr. per week, both terms.

Lectures on specifications, testing and methods of testing non-metallic mineral products.

254*i*. Non-Metallic Minerals Laboratory. R. J. Montgomery.

Department 8a, IV Year; 6 hrs. per week, both terms.

Advanced work on the compounding and testing of non-metallic mineral products.

254*j*. Ceramic Building Materials. R. J. Montgomery.

Department 4, IV Year; 1 hr. per week, second term.

Lectures on the composition, manufacture, properties, and use of ceramic building materials.

MINERALOGY

255. Elementary Mineralogy. J. E. Thomson.

Departments 2, 5, 8, 8a and 9, I Year; 2 hrs. per week, first term.

After introducing the student to the chief chemical, physical, and crystallographic characteristics of minerals, the course becomes descriptive and deals with about one hundred of the minerals most important from the industrial or scientific point of view.

Text book: Text-book of Mineralogy—Dana.

256. Mineralogy. J. E. Thomson.

Department 6, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

Introduction to determination of minerals by inspection and physical tests.

Text book: Mineral Tables—Eakle.

257. Primary Mineralogy. J. E. Thomson.

Department 1, II Year; 2 hrs. per week, first term.

A very brief introduction to the study of minerals and rocks.

Text books: Minerals and How to Study Them—Dana. Handbook of Rocks—Kemp.

258. Mineralogy. J. E. Thomson.

Department 2, I Year; 1 hr. per week, first term; 3 hrs. per week, second term.

Determination of minerals by inspection and by means of physical tests; introduction to blow-pipe practice.

Text books: Mineral Tables—Eakle. Determinative Mineralogy—Lewis.

258*a*. Mineralogy. J. E. Thomson.

Departments 5, 8, 8a and 9, I Year; 1 hr. per week, first term.

Determination of minerals by inspection and by means of physical tests.

Text book: Mineral Tables—Eakle.

259. Mineralogy. J. E. Thomson.

Department 1, II Year; 1 hr. per week, first term; 2 hrs. per week, second term.

Determination of minerals by inspection and by means of physical tests; study of common rock types and their identification.

Text books: Mineral Tables—Eakle. Handbook of Rocks—Kemp.

260. Elementary Petrography. V. B. Meen.

Departments 2 and 9, II Year, and Departments 5g and 8a, III Year; 1 hr. per week, both terms.

A course of lectures and laboratory work introducing the student to the microscopic study of rocks.

Text book: Handbook of Rocks—Kemp.

261. Mineralogy. J. E. Thomson.

Departments 2 and 9, II Year; 2 hrs. per week, both terms.

Determination of minerals by means of the blow-pipe and physical properties.

Text books: Mineral Tables—Eakle. Determinative Mineralogy—Lewis.

262. General Petrography. A. L. Parsons.

Departments 2 and 9, III Year, and Departments 5g and 8a, IV Year; 1 hr. per week, both terms.

Study of the chief rock-forming minerals and of some phases of petrography not covered in the course of the previous year.

Text books: Minerals in Rock-Sections—Luquer. Petrology for Students—Harker.

263. Petrography. V. B. Meen.

Departments 2 and 9, III Year, and Departments 5g and 8a, IV Year; 2 hrs. per week, both terms.

Study of the chief rock-forming minerals, of rocks in thin sections and in hand specimens.

Text books: Petrology for Students—Harker. Minerals in Rock Sections—Luquer.

263*a*. Petrographic Methods. A. L. Parsons.

Department 9, IV Year; 2 hrs. per week lectures and laboratory, both terms.

Methods for determining microscopic mineral powders.

Reference book: The Microscopic Determination of the Non-opaque Minerals—Larsen.

263*b*. Mineralography. J. E. Thomson.

Department 9, IV Year; 2 hrs. laboratory per week, both terms.

The study of opaque minerals by microscopic methods with reflected light.

Reference book: Determination of the Opaque Minerals—Farnham.

264. Mineralogy. A. L. Parsons.

Department 5s, III Year; 1 hr. lecture per week, both terms.

A lecture course on morphological crystallography.

Reference book: Crystallography—Walker.

MODERN LANGUAGES

265. German. H. Boeschenstein.

Department 6, I Year, 2 hrs. per week, both terms; II, III and IV Years, 1 hr. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

265*a*. German. C. Barnes.

Department 5, I Year; 2 hrs. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: First German Course for Science Students—Fiedler and Sandbach.

265*b*. German. C. Barnes.

Department 5, II Year; 1 hr. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: Second German Course for Science Students—Fiedler and Sandbach.

266. Spanish.

Department 6m, IV Year; 1 hr. per week, both terms.

An introduction to Spanish grammar, pronunication and practice in reading Engineering Spanish.

MUNICIPAL ENGINEERING

267. Sanitary Engineering. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. lecture per week, both terms.

267a. Sanitary Engineering. A. E. Berry, W. J. Smither.

Department $1a_1$, IV Year; 3 hrs. laboratory per week, second term (course 179).

Consideration is given to the problems of water supply, sewerage and municipal sanitation as viewed by the engineer. The lectures and laboratory work include the design of water distribution and sewer systems, as well as water and sewage treatment works. Problems are assigned from assumed data and from material secured in the field. Excursions to places of interest are also arranged from time to time.

Reference books: Public Water Supplies—Turneaure and Russell. Manual of Water Works Practice of the American Water Works Association. American Sewerage Practice—Metcalf and Eddy, 3 vols. Solving Sewage Problems—Fuller and McClintock.

268. Highway Engineering. W. L. Sagar.

Department $1a_1$, IV Year; 1 hr. lecture per week, second term, and 3 hrs. laboratory per week, second term.

This course of instruction deals with the design, construction and maintenance of highways and street pavements, and with the pro-

perties of the materials employed. The laboratory course deals with subsoils, bituminous and non-bituminous materials of construction.

Text books: Construction of Roads and Pavements—Agg. Rural Highway Pavements—Harger.

RAILWAY ENGINEERING

269. Railway Engineering. W. M. Treadgold.

Department $1a_2$, IV Year; 1 hr. per week, first term, 2 hrs. per week, second term, and 4 hrs. per week, second term, in the drafting room.

This course of lectures and practical work is intended to make the student acquainted with the general principles of railway engineering and transportation. The economic theory of location, train resistance, effect of grade distance and curvature rise and fall, maintenance of way, yards and terminals, tunnels and street railway practice; also the principles of urban and interurban transportation.

Text books and references: The Economic Theory of Railway Location—A. M. Wellington. Proceedings of the Railway Engineering Association.

269*a*. Railway Structures. C. R. Young.

Department $1a_2$, IV Year; 1 hr. lecture per week, first term; 2 hrs. laboratory per week, second term (course $178a_2$).

A course of lectures with exercises covering alternative bridge layouts with comparative estimates of costs, temporary and permanent trestles, tunnels, tunnels vs. bridges, buildings, turn-tables, snow-sheds and shelters.

SURVEYING

270. Surveying. S. R. Crerar.

Departments 1, 2 and 9, I Year; 1 hr. per week, both terms.

Departments 3, 7, 8 and 8a, I Year; 1 hr. per week, first term.

The lecture course includes the general principles and practice of surveying with the chain, the transit, and the level with special attention given to co-ordinate surveying.

Text books: Plane Surveying—Tracy. Elementary Surveying —Breed and Hosmer.

270*a*. Surveying. T. L. Rowe.

Department 4, I Year; 1 hr. per week, first term.

The lecture course includes the general principles and practice of surveying with the chain, the transit, and the level, with special consideration given to the survey of lots and small estates.

271. Field Work. S. R. Crerar, J. W. Melson, T. L. Rowe.

Departments 1, 2 and 9, I Year; 6 hrs. per week, first term.

Departments 3, 7, 8 and 8a, I Year; 6 hrs. per week to December 1.

This course comprises practice in chaining; a complete survey of a piece of land with the chain and transit; keeping of field notes; the use of the transit in surveying closed figures and traverse lines and in ranging straight lines; plotting by latitudes and departures and otherwise computing areas; instrumental work with the level; also use of level and transit in setting out a proposed building and calculating the volume of excavations required.

271*a*. Field Work. T. L. Rowe.

Department 4, I Year; 3 hrs. per week, first term.

This course comprises practice in chaining, a complete chain survey of a small estate, keeping field notes, the use of the transit and level and their application in building layouts, cross section work with the level, including calculation for excavations.

272. Surveying. W. M. Treadgold.

Department 1, II Year; 1 hr. per week, both terms.

This course of lectures takes up in detail, simple, reverse and compound curves as applied to railroad and highway surveying. It also includes stadia, plane table and photographic surveying as applied to topographic work, and the main features of mine and hydrographic and aerial surveying.

Text books: Henck, Searles, Allen (Field books for Engineers) Theory and Practice of Surveying—Davis, Foote and Rayner. Surveying—Breed and Hosmer.

272*a*. Surveying. E. W. Banting.

Departments 2 and 9, II Year; 1 hr. per week, both terms.

This course of lectures takes up mine surveying with problems related thereto. It also includes the simple curve as applied to railroad surveying, stadia topographical surveying, plane table and the main features of hydrographic surveying.

Text books: Surveying—Breed and Hosmer. Mine Surveying Durham.

273. Field Work. W. M. Treadgold, E. W. Banting.

Department 1, II Year; 9 hrs. per week, first term.

Departments 2 and 9, II Year; 6 hrs. per week, first term.

This course of instruction embraces all adjustments of the transit and level, minor problems in triangulation and traversing, levelling and plane table practice, curves and topography.

274. Surveying. W. M. Treadgold.

Department 1, III Year; 1 hr. per week, both terms.

This course of lectures takes up the work of the railroad engineer on construction, including profiles, cross-sectioning, computation of

volume of earthwork, overhaul, transition curves, laying out turnouts, frogs and switches, etc. Also a discussion of trigonometric and barometric levelling.

Text books: Field Engineering—Searles. Railroad Curves and Earthworks—Allen.

Photographic Surveying, see 189, 189a.

275. Survey Camp. W. M. Treadgold, S. R. Crerar, E. W. Banting, J. W. Melson.

Departments 1, 2 and 9, III Year; Department 1b, IV Year.

The University of Toronto Survey Camp is ideally located in County of Haliburton at an elevation of 1,000 feet above sea level and comprises a tract of field, woodland and lake front property. The country is broken and rolling and with the numerous small lakes and streams in the immediate vicinity is admirably suited for work and the various problems that arise in practical surveying. Since the camp has been established, Professor Stewart has made a careful triangulation survey, establishing triangulation stations near the camp connected with primary stations of the Geodetic Survey of Canada. This triangulation has been adjusted and complete computations made. Also through the interest and co-operation of Mr. Noel Ogilvie, Director of the Geodetic Survey, permanent bench marks were established at Miner's Bay on Gull Lake, connecting up levels with the precise level net of Canada.

By rail the camp may be reached by taking the Canadian National train leaving Lindsay for Haliburton, getting off at Gelert, where conveyances are always on hand to drive to the camp, a distance of 12 miles, by way of Minden, the county town.

All mail, telegrams, or telephone messages should be addressed to the "University Survey Camp, Minden, Ontario". Baggage should be checked to Minden via Gelert on the Canadian National Railway.

Each student will provide at least three pairs of heavy blankets, sheets, towels, raincoats, personal supplies, all of which should be limited to about 60 lbs., and carried in suit cases or dunnage bags.

This course includes:

(*a*) Secondary Triangulation and Base Line Measurements.
(*b*) Stadia, Plane Table and Boundary Traverses.
(*c*) Highway and Railway Location.
(*d*) Cross Sectioning and Computation of Earthwork.
(*e*) Stream Gauging and Discharge Measurements.
(*f*) Hydrographic Surveying.
(*g*) Photographic and Micrometer Work.
(*h*) Stadia and Plane Table Topography.
(*i*) Mine Surveying.
(*j*) Observations for Time, Azimuth and Latitude.
(*k*) Geological Survey.

A complete field course in Practical Astronomy and Geodesy is given to students taking this option in the Fourth Year, Department of Civil Engineering including the adjustment of a triangulation, observations for time, latitude and azimuth and base line measurements.

Students in Departments 1 and 2 will be required to take the Survey Camp between the Second and Third Year; and, on failure to do so, this subject will be carried as a supplemental in the Third Year.

PRACTICAL EXPERIENCE

276. Practical Experience.

Department 7.

Each student registered in the Department of Electrical Engineering is required to submit to the Secretary of the Faculty, not later than January 15th in each session, certificates and a detailed report regarding practical experience. Certificate forms, the nature of the report, and information regarding the kinds of experience to be sought, are available at the office of the Secretary.

PHYSICAL TRAINING

280. Physical Training. G. D. Porter.

Required in all Departments, I and II Years, and optional in the III and IV Years.

By order of the Board of Governors, each male undergraduate proceeding to a degree must take Physical Training in the first and second academic years of his course. In each session in which Physical Training is compulsory he must first undergo a medical examination by the Director of the University Health Service, and must then register for Physical Training at the office of the Athletic Association in Hart House. Students of all years who wish to take part in any form of athletics or physical exercise, must first undergo a medical examination by the Director. Those classified as A1 may elect to take any form of competitive athletics during the season in which that form of sport is in progress.

Military training in the C.O.T.C. constitutes an option in Physical Training (see page 165).

ZYMOLOGY

283. Zymology.

Department 6z, IV Year.

A study of the phenomena of fermentation and of the mechanism of enzyme action.

THESIS

285. Thesis.

Required in all Departments, IV Year, with the exception of Department 4, Architectural Design Option and Departments 5g and 5i. Department 3, IV Year; 1 hr. per week, both terms. For requirements in Department 2, see course 67, and in Department 6, see course 113.

Each student must prepare a thesis on a subject and in a form approved by the head of the department in which the student is registered.

ADVANCED MATHEMATICS

See Mathematics, p. 111

Elective courses in Mathematics are offered to students of the I and II Years. Students of the I Year will be informed at the beginning of the fall term whether or not they are qualified to proceed with the advanced course. Those who take this course will try the ordinary pass examination papers, plus an advanced problem paper at the end of the year. The pass standing for proceeding to the Second Year will be determined by the ordinary paper, the marks of the problem paper being used to determine whether or not the student has shown sufficient proficiency to take the advanced work of the Second Year.

Students of the Second Year taking the advanced course will try the ordinary pass examination papers plus an advanced problem paper, pass standing being determined by the ordinary papers and proficiency for further advanced work by the problem paper.

Although these courses are entirely elective, students who are qualified to take them are urged to proceed with this work.

The names of those who pass these advanced papers will be published with the regular results each year as having completed these courses.

290. Advanced Mathematics. The Staff in Mathematics.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 3 hrs. lecture per week, first term; 4 hrs. lecture per week, second term.

In addition to the regular material included under courses 236, 238, students will take work on advanced problems on conics; parametric equations on conics; curve tracing and asymptotes; circular and hyperbolic functions; expansions of functions of one variable; partial fractions; elementary theory of equations; determinants up to the third order; one-parameter families of curves and their differential equations; differential equations in elementary mechanics; curve fitting and approximate integration.

291. Advanced Mathematics. The Staff in Mathematics.

Departments 1, 3, 6, and 7, II Year; 2 hrs. lectures per week, both terms.

In addition to the regular material included under course 237, students will take work on elementary space geometry; partial differentiation; expansions of functions of more than one variable; multiple integration; ordinary differential equations of first order and first degree; linear differential equations with constant coefficients; applications to problems in mechanics.

292. Algebra and Calculus. F. M. C. Goodspeed.

Department 5, I Year; $3\frac{1}{2}$ hrs. per week, both terms.

Polynomials and rational functions, elementary theory of equations, inequalities, determinants, limits, summation of series, binomial, exponential, and logarithmic series, expansions of the circular and hyperbolic functions and their inverses, the methods and operations of the Calculus considered intuitively and illustrated by applications, and elementary differential equations.

Text book: Introduction to the Calculus—Osgood.

293. Analytical Geometry of the Plane. F. M. C. Goodspeed.

Department 5, I Year; $1\frac{1}{2}$ hrs. per week, both terms.

Cartesian and polar coordinates, transformation of coordinates, straight lines and curves of the second degree, projective properties of conics, the principle of duality, higher plane curves.

Text book: Analytical Geometry—Nowlan.

294 Differential Calculus. W. L. Halperin.

Department 5, II Year; 3 hrs. per week, both terms.

Differentiation, Taylor's theorem and series for functions of one or more variables, families of curves and surfaces and their differential equations, Jacobians, geometrical and mechanical applications.

Text books: Introduction to the Calculus—Osgood. Differential and Integral Calculus, Vol. I—Courant.

295. Integral Calculus and Differential Equations. W. L. Halperin.

Department 5, II Year; 3 hrs. per week, both terms.

The indefinite integral, integration of rational and other special functions, the definite integral, differentiation with respect to a parameter, multiple integration, Fourier's series, geometrical and mechanical applications, approximate integration, introduction to ordinary differential equations.

Text books: Introduction to the Calculus—Osgood. Differential and Integral Calculus, Vol. 1—Courant.

296. Analytical Geometry of Space. W. L. Halperin.

Department 5, II Year; 1 hr. per week, both terms.

Cartesian and other systems of point coordinates, curves and surfaces and their equations in parametric or non-parametric form, data fixing planes, lines, conics, and quadrics, generating lines and circular spectrons of quadrics, classification of quadrics, tangent cones to quadrics, metric and projective properties of quadrics, families of quadrics, ruled surfaces and surfaces of revolution.

Text book: Analytic Geometry—Nowlan.

297. Differential Equations. R. Brauer.

Department 5, III Year; 1 hr. per week, both terms.

First order equations solvable by quadratures, depression of the order, the linear equation, systems of linear equations with constant coefficients, first order partial equations in two variables, total differential equations, particular equations of the second order.

Text books: Differential Equations—Piaggio. Differential Equations—Cohen.

298. Introduction to the Theory of Functions. R. Brauer.

Department 5, III Year; 1 hr. per week, both terms.

Green's and Stokes's Theorems, conformal mapping of one plane region on another, the complex variable, analytical functions, Cauchy's Theorem and Integral Formula, Poisson's Formula, Taylor's and Laurent's series, analytic continuation and the Schwarz reflection principle, singularities and their significance.

Text book: Theory of Functions—Rothe, Ollendorff, and Pohlhausen.

PHYSICS

301. Properties of Matter, Mechanics, and Heat. John Satterly.

Department 5, I Year; 3 hr. lecture per week and 4½ hrs. laboratory per week, both terms.

This course involves lectures and laboratory work supplementing the work taken in the lectures. In addition to the work in the divisions indicated in the title, the course also includes lectures and problems on calculations for science students involving the use of the elementary calculus and statistics. The course is planned in conjunction with the work taken under the title of Engineering Mechanics.

Reference books: Dynamics—Duncan and Sterling. Heat—Gray. Analytical Mechanics—Barton. Mechanics of Fluids—Barton. Properties of Matter—Wagstaff. Heat—Stewart and Satterly. Heat—Draper. Mathematical and Physical Tables—Clark. Calculus made easy—Thompson. Theory of Measurements—Tuttle and Satterly.

302. Elementary Magnetism and Electricity. L. Gilchrist.

Department 5, II Year; 1 hr. lecture per week, first term; 2 hrs. lecture per week, second term.

This course deals with the fundamental theory of magnetism and electricity, including the introduction of electron theory and alternating currents.

Reference books: Advanced Text-book of Magnetism and Electricity—Hutchinson. A treatise on Electricity—Pidduck. Electricity and Magnetism—Starling. Mathematical Physics, Vol. 1—Barlow.

303. Elementary Light. H. A. McTaggart.

Department 5, II Year; 1 hr. lecture per week, both terms.

This course deals with the fundamental theory of light, including treatment of interference, diffraction, polarized light, and the introduction of geometrical optics.

Reference books: Light for Students—Edser. Introduction to Physical Optics—Robertson. Optical Measuring Instruments—Martin.

304. Acoustics. E. F. Burton.

Department 5, II Year; 1 hr. lecture per week, first term.

This course deals with the fundamental theory of acoustics, including stationary waves and elementary treatment of architectural acoustics and sound transmission.

Reference books: Science of Musical Sounds—D. C. Miller. Speech and Hearing—Fletcher. Sound—A. B. Wood. Acoustical Engineering—West. Sound—F. R. Watson.

305. Magnetism and Electricity, Light, and Acoustics.

Department 5, II Year; 3 hrs. laboratory per week in the first term, and 6 hrs. laboratory per week in the second term.

This laboratory work is carried out under the direction of the staff in Physics and covers lectures dealt with in courses 302, 303 and 304.

306. Mathematical Operations Applied to Physics. C. Barnes.

Department 5, III Year; 1 hr. lecture per week throughout the year.

This course involves an account of vectors illustrated by the application of vector algebra to physical problems, and an elementary treatment of such things as Fourier Series and Spherical Harmonics.

307. Theory of Potential and Electrical Measurements. E. F. Burton.

Departments 5c, 5s, 5g and 5i, III Year; 1 hr. lecture per week throughout the year.

This course deals with the elementary theory of potential as applied particularly to electricity and magnetism.

Reference books: Electricity and Magnetism—Starling. Principles of Electricity—Page and Adams.

309. Properties of Matter. John Satterly.

Department 5, III Year; 2 hrs. lecture per week throughout the year.

This course involves advanced work on properties of matter, dealing very intensively with gravitation, elasticity, viscosity, surface tension and kinetic theory of gases.

Reference books: Properties of Matter—Poynting and Thomson. General Properties of Matter—Newman and Searle. Applied Mathematics—Perry. Experimental Physics—Searle. Practical Physics—Watson. The Mechanical Properties of Fluids—Drysdale and others.

310. Heat. John Satterly.

Departments 5c, 5s, 5g, 5h and 5i, III Year; 1 hr. per week, both terms.

A study of thermometry and pyrometry, the absolute scale of temperature, the mechanical equivalent of heat, the kinetic theory of gases, equations of state, low temperature work, specific heats, vaporization, fusion, expansion, transfer of heat by conduction and convection; radiation and radiation pyrometry, the second law of thermodynamics and its simple applications.

Reference books: Heat and Thermodynamics—Roberts. Methods of Measuring Temperature—E. Griffiths.

311. Physical Laboratory.

Department 5, III Year; 3 hrs. laboratory per week, both terms.

This laboratory work includes experiments illustrating the principles involved in the four preceding courses.

312. Optics. H. A. McTaggart, K. B. Jackson.

Departments 5c, 5s, 5g, 5e and 5i, III Year; 1 hr. lecture and 3 hrs. laboratory per week throughout the year.

Department 5h, III Year; 1 hr. lecture and 3 hrs. laboratory per week, second term.

This course deals with geometrical and physical optics and photometry as applied to optical instruments and with photography as a scientific implement.

Reference books: Optical Measuring Instruments—Martin. Photometry—Walsh.

313. Hydrodynamics. H. A. McTaggart.

Department 5h, III Year; 1 hr. per week, both terms.

A lecture course for beginners on the hydrodynamics of a perfect fluid with applications to motion in liquids and gases. Reference will be made to some of the simpler cases of viscous flow. The course will be illustrated by experiments.

Text books: Treatise on Hydromechanics—Ramsay. Aerofoil and Airscrew Theory—Glauert. The Physics of Solids and Fluids—Ewald, Poschl and Prandtl. Hydro and Aeromechanics—Prandtl-Tietjens.

314. Advanced Mathematical Operations used in Physics. C. Barnes.

Departments 5c, 5s, 5h, 5e and 5i, IV Year; 1 hr. per week, both terms.

This is a continuation of course 306 to include further properties of vector fields, Cartesian tensors, boundary value problems in potential theory, simple problems in calculus of variations, and certain partial differential equations.

315. Conduction through Gases, Radioactivity and Atomic Structure. John Satterly.

Departments 5c and 5s, IV Year; 1 hr. per week, both terms.

Kinetic theory of gases, electrical discharge through gases, the electron, elementary X-rays and crystal structure, ionization, the development of radioactivity and its use in the physical and geological sciences.

Text: Ions, Corpuscles and Ionizing Radiations—Crowther.

Reference books: The Atom—Andrade. Radioactivity—Chadwick. Radioactivity—Rutherford. Heat—Poynting and Thomas.

316. Advanced Acoustics. D. S. Ainslie.

Departments 5c, 5s and 5i, IV Year; 1 hr. per week, first term.

This course deals with the properties and transmissions of acoustical waves. It will bring out the analogies in alternating current theory and other fields in physics. Sound resonance and sound filters.

Texts: Acoustics—Stewart and Lindsay. Applied Acoustics Olson and Massa. Acoustical Engineering—West.

317. Physical Laboratory. H. J. C. Ireton.

Department 5c, IV Year; 3 hrs. per week, both terms.

Department 5s, IV Year; 9 hrs. per week, both terms.

This laboratory course is designed to accompany the lecture courses 315, 316, 318, 319 and 321.

318. Advanced Optics. H. A. McTaggart, H. J. C. Ireton.

Department 5s, IV Year; 1 hr. per week, both terms.

A lecture course on the aberrations in optical instruments and on the interference, diffraction and polarisation of light with practical applications.

Texts: Applied Optics—Martin. Course d'Optique—Bruhat. The Diffraction of Light, X-Rays, etc.—Meyer. Applied Optics and Optical Design—Conrady.

319. Series Spectra. H. J. C. Ireton.

Department 5s, IV Year; 1 hr. per week, second term.

A lecture course outlining the early developments in atomic spectroscopy, the origin of spectral lines, and their empirical classification into series. The application of the derived formulae to hydrogen, helium and the alkali metals is given.

Reference books: Introduction to Modern Physics—Richtmeyer. Introduction to Atomic Spectra—White.

320. Elementary Quantum Theory. Miss E. J. Allin.

Department 5s, IV Year; 1 hr. per week, second term.

The fundamental principles of the quantum theory developed from a historical and experimental standpoint, radiation formulae, photoelectric effect, Compton effect, specific heats.

Reference book: Théorie des Quanta—Bloch.

321. X-Rays and Crystal Structure. H. J. C. Ireton, J. O. Wilhelm.

Department 5s, IV Year; 1 hr. per week, both terms.

The fundamental physical principles of X-rays, their production, properties and applications to the study of crystalline structure. The practical significance of the results obtained is outlined.

Reference books: The Crystalline State—Bragg and Bragg. Applied X-rays—Clark.

322. Geophysics. L. Gilchrist.

Departments 5g and 9, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, both terms.

The course involves a study of the physical principles underlying the methods of investigating surface geological structure and the location of mineral deposits. Particular attention is given to magnetic, electrical, electromagnetic, gravitational, seismological, thermometric and radioactive methods of investigation. In the laboratory, experiments which are illustrative of the methods are carried out and typical problems are investigated.

Reference books: A Manual of Seismology—Davison. Modern Seismology—Walker. Lehrbuch der Geophysik—Gutemberg. Elements of Geophysics—Ambronn. Applied Geophysics—Eve and Keys. Geophysical Prospecting, 1929—A.I.M.E. Geophysical Prospecting, 1932—A.I.M.E. Geophysical Prospecting, 1934—A.I.M.E. Publications of Geological Survey, Department of Mines, Ottawa, Memoirs, 165, 170.

323. Wave Motion in Elastic Media. L. Gilchrist.

Departments 5g and 5e, IV Year; 1 hr. per week, both terms.

The course involves the development of the differential equations for the propagation of various types of disturbance through different media. A study is made of the solution of these equations having regard to the initial and final conditions and the boundary conditions of the media associated with the propagation of the disturbance. Typical problems are considered such as (*a*) the propagation of vibrations in strings, rods, membranes and plates, (*b*) the propagation of heat and electricity in planes, cylinders and spheres.

Reference books: Fourier's Series and Spherical Harmonics—Byerly Spherical Harmonics—MacRobert.

324. Physics of Light Production—H. J. C. Ireton.

Department 5i, IV Year; 1 hr. per week, both terms.

A course of lectures dealing with black body radiation, spectral energy distribution and the principles involved in the production of light in various types of sources, filament, flame, and gaseous and vapour tubes.

325. Physical Laboratory. H. J. C. Ireton.

Department 5i, IV Year; 3 hrs. per week, both terms.

A laboratory course to accompany Course 324.

326. Dynamic Meteorology. B. Haurwitz.

Department 5h, IV Year; 1 hr. per week, both terms.

A lecture course intended as an introduction to meteorology applicable to aeronautics. It will deal in elementary form with the statics, dynamics and thermodynamics of the atmosphere. Particular emphasis will be laid on the points which are most important for airplane flight, such as atmospheric turbulence, atmospheric conditions producing an ice coat on airplanes and the interpretation of weather reports and weather maps.

APPLIED MATHEMATICS

331. Theoretical Mechanics. J. L. Synge.

Department 5, III Year; 1 hr. per week, both terms.

The course deals with the dynamics of a particle on a curve and in two dimensions and the dynamics of rigid bodies in two-dimensional motion.

Text-book: Dynamics—Lamb.

332. Differential Equations of Mathematical Physics. A. F. Stevenson.

Department 5, IV Year; 2 hrs. per week, both terms.

The course deals with the underlying theory and with important particular equations, and includes separation of variables, eigenvalues and eigenfunctions, Fourier series, Laplace's equation, Bessel's equation, wave equation (including vibration of strings and membranes, sound waves, electromagnetic waves), equation of heat conduction, Green's function, introduction to integral equations.

333. Theory of Elasticity. J. L. Synge.

Department 5e, IV Year; 1 hr. lecture and 1 hr. laboratory per week, both terms.

The course covers the more fundamental parts of the mathematical theory of elasticity and includes a general discussion of strain, finite and infinitesimal, and of stress, stress-strain, relations for an isotropic body, equations of equilibrium, shell or tube under pressure, torsion and flexure, strain-energy function, anisotropic bodies and cases of elastic symmetry.

334. Theoretical Hydrodynamics. J. L. Synge.

Department 5h, IV Year; 2 hrs. per week, both terms.

The course deals with the theory of the motion of perfect and viscous fluids including irrotational motion in two and three dimensions, dynamics of solids and liquids, vortices, wave motion, motion on rotating earth, viscous flow in tube and between parallel planes, Couette motion, equations of Stokes and Oseen.

335. Dynamics. B. A. Griffith.

Department 7, II Year; 1 hr. lecture and 1 hr. problems per week, both terms.

A course in theoretical dynamics including the motion of a particle on a straight line and in a plane, simple harmonic motion, the circular pendulum, projectiles, centre of gravity, moments of inertia, motion of a rigid body about a fixed axis, impulsive motion, problems on rolling and sliding.

Text book: An Introduction to Mechanics—J. W. Campbell.

AERONAUTICS

341. Aircraft. T. R. Loudon.

Department 5h, III Year; 1 hr. per week, both terms.

This is an introductory course in which the various types of aircraft and their component parts are described. The principles of flight are gone into and an elementary discussion of aerodynamic forces and coefficients is given.

Text book: Technical Aerodynamics—Wood.

342. Aerodynamics. T. R. Loudon, M. J. C. Lazier.

Department 5h, IV Year; 2 hrs. per week, both terms.

This course of lectures extends the theory of hydrodynamics to the case of theoretical determination of forces resulting from flow around an airfoil. The theory of model testing and scale effect is discussed and a complete analysis is made of conditions of longitudinal and lateral stability. The problem of the lighter than air craft is also discussed.

Text books: Aerofoil and Airscrew Theory—Glauert. Technical Aerodynamics—Wood. Airplane Design—Warner.

344. Airplane Design and Stress Analysis. T. R. Loudon, C. F. Morrison.

Department 5h, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, both terms.

The more advanced theory of structural design is gone into as a continuation of Course 7, III Year. The properties of materials used in aircraft construction are discussed; and problems are worked out on the design of aircraft for given aerodynamic and structural specifications.

Text books: Technical Aerodynamics—Wood. Airplane Structures—Niles and Newell.

345. Hydrodynamics. T. R. Loudon, M. J. C. Lazier.

Department 5h, IV Year; 6 hrs. laboratory per week, both terms.

This course is intended to amplify the lecture courses on hydrodynamics and aerodynamics. The calibration and practical use of wind tunnel instruments is explained, and a series of experiments is carried out on the determination of forces and moments acting on various airfoil arrangements.

SECTION X. EXAMINATIONS

ANNUAL

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in all subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations are 50 per cent. in the Department of Engineering Physics and 40 per cent. in all other Departments, with an average of 50 per cent. The pass marks required in the laboratory work of all Departments are 60 per cent. In the Department of Engineering Physics an average of 60 per cent. will be required in the written and practical work of the Second, Third and Fourth Years. Candidates who have attained the required average and who have failed in not more than two subjects will be required to pass supplemental examinations in those subjects to secure pass standing.

5. Honours will be granted to students who, at the annual examinations, obtain at least 50 per cent. in each written subject, at least 60 per cent in each laboratory subject, and 75 per cent. of the total number of marks allotted to the subjects of their course.

6. Honour graduate standing will be granted to those who obtain honours in the final and in one previous year.

7. Candidates who fail to secure promotion in any year will be required to take again the whole course of instruction of the year in which they fail before presenting themselves a second time for examination.

8. A student failing in the First or Second Year of the Department of Engineering Physics will not be permitted to repeat the year in this Department.

9. A student who, in either term of the session, fails to perform satisfactorily the work of his course may not be allowed to present himself at the final examinations of the year.

10. A student should submit to Council immediately after its occurrence evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day ot examinations.

11. A student who has failed to complete satisfactorily the course in Physical Training prescribed for the First Year will not be permitted to register in the Third Year; and the student who has failed to complete satisfactorily the course in Physical Training prescribed for the Second Year will not be permitted to register in the Fourth Year.

12. A student will not be allowed to write any examination if he has not paid all fees and dues for which he is liable at that time.

13. Unless special permission is granted by the Council of the Faculty concerned, a student will not be permitted further registration in the University if, at the end of two sessions spent in the same year of the Faculty in which he is registered, he has failed to obtain the standing necessary to qualify him for registration in the succeeding year of the Faculty. An appeal from the decision of the Faculty Council may be made to the Senate.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on the 14th day of September, 1937. Application (on the prescribed form) to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 15th, and the fee named in Sec. VI, para. 5 received by the Bursar not later than September 1st. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements. Arrangements will be made to conduct supplemental examinations at the Survey Camp for those students in attendance at the camp.

2. If a candidate desires to write upon an annual examination as a supplemental, his application must be received by the Secretary and his fee by the Bursar, for the January examinations not later than December 1st and for the April examinations not later than March 1st.

3. Pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

SECTION XI. SCHOLARSHIPS

Through the generosity of friends of the University, encouragement has been given to both undergraduate and graduate work in its various branches, by establishing the following scholarships, prizes, bursaries and medals.

A student will not be allowed to hold more than one of the following scholarships marked with an asterisk, but the published lists will show all those to which he would have been entitled, but for this provision. The Council may, at its discretion, award unallotted scholarships to the next eligible candidate.

Name	Years eligible	Amount	See page
*Baptie Scholarship	I	$100	135
*Harvey Aggett Memorial Scholarship	II	$75	135
*Boiler Inspection & Insurance Co. Scholarship	III	$150	135
*Jenkins Scholarship	III	$100	135
B.A.A.S. Medal	IV	....	136
Toronto Architectural Guild Medal	V	....	136
O.A.A. Scholarship	II	$100	136
Toronto Brick Company Prizes	IV	$75 & $25	136
Darling and Pearson Prize	V	$100	136
Heating and Ventilating Engineers Prize	III, IV	$25	137
E. I. C. Prize	III	$25	137
*Ceramics Scholarship	III	$50	137
MacLennan-MacLeod Memorial Prize	I	$25	137
J. A. Findlay Scholarships	II, III	....	138
R.A.I.C. Medal	V	....	138
Rhodes Scholarships	II, III, IV	£400	139
Ubukata Fund	All	....	139
F. W. Jarvis Bursary	All	$50	139
U. of T. War Memorial Scholarships	All	$200	140
U. of T. War Memorial Fellowships	Graduate	$500	140
McCharles Prize	All & Grad.	$1,000	140
1851 Exhibition Science Research Scholarship	Graduate	£250	141
Nipissing Mining Co. Research Fellowship	Graduate	$1,100	142
Elizabeth Speller Memorial Fund	III, IV	....	143
Engineering Society Loan Fund	....	....	143

NOTE: On account of the continued tendency towards lower rates of interest it is possible that the value of certain scholarships or prizes at the time of payment may prove to be less than the amount stated in the calendar.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that from the income therefrom a scholarship of One Hundred Dollars shall be awarded to engineering students on the record of their first year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the Annual Examinations of the First Year, enrolled in any one of the departments of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those departments. The first award was made on the results of the annual examinations of the Session 1925-26.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of Seventy-five Dollars is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a Scholarship in the Department of Mechanical Engineering of the value of One hundred and fifty Dollars to the student who obtains highest Honour Standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Bursar to the fees of the Fourth Year of the successful candidate.

JENKINS SCHOLARSHIP IN ENGINEERING

The Jenkins Scholarship in Engineering, presented by Jenkins Bros., Limited, has been donated to continue for a period of fifteen years, the first award having been made in 1925.

This annual scholarship, of the value of One Hundred Dollars, is to be awarded to the student of the Third Year registered in one of the six departments of Civil, Mining, Mechanical, Chemical, Electrical or Metallurgical Engineering, who has the highest aggregate of percentages for the First, Second and Third years.

B.A.A.S. MEDAL

A bronze medal has been donated for students of the Faculty of Applied Science and Engineering by members of the British Association for the Advancement of Science. This Medal will be awarded to the student of the Fourth Year, in any department, who, taking honours, obtains the highest aggregate percentage in practical and written examinations in the year.

TORONTO ARCHITECTURAL GUILD MEDAL

The Toronto Architectural Guild was the organization of local architects from which sprung the Ontario Association of Architects. When the new and wider association became firmly established, the Guild disbanded and handed over to a trustee board certain funds for the establishment of a medal to be awarded in the School of Architecture of the University of Toronto.

The Trustee Board, now that the fund has accumulated considerably, announces its intention of awarding this medal annually to a senior student showing outstanding ability in Architectural Design.

ONTARIO ASSOCIATION OF ARCHITECTS SCHOLARSHIP

The Ontario Association of Architects offers a scholarship of One Hundred Dollars to the student of the Second Year in the School of Architecture who at the annual examinations obtains the highest honour standing in Architectural Design. The scholarship was awarded annually from 1928 to 1935 inclusive and has been extended for a further period of five years.

TORONTO BRICK COMPANY PRIZES

The Toronto Brick Company offers two prizes, one of Seventy-five Dollars and one of Twenty-five Dollars to those students of the Fourth Year in the School of Architecture who win first and second places in a competition arranged by the Staff in the School of Architecture for this purpose.

DARLING AND PEARSON PRIZE IN ARCHITECTURE

Messrs. Darling and Pearson, Architects, offer annually a prize of One Hundred Dollars in books to the student in the final year of the School of Architecture who is assigned the highest marks in a special problem in Architectural Design, set for this purpose by the School of Architecture. The books constituting this prize are to be selected by the successful candidate, with the approval of the School of Architecture.

The first award of this prize was made in the Session 1927-28.

HEATING AND VENTILATING ENGINEERS PRIZE

The Ontario Chapter of the American Society of Heating and Ventilating Engineers offers an annual prize of Twenty-five Dollars for a period of five years commencing 1931. The period was extended indefinitely in 1935. The prize will be awarded to the student in either the Third of Fourth Year in the Department of Mechanical Engineering who, in the opinion of that Department, has written the most satisfactory thesis on subjects dealing with Heating and Ventilation, such thesis being prepared under special arrangement made by the Department, the result to be reported to Council at the time of the annual examination results. The thesis must be handed in not later than March 1st. The prize will not necessarily be awarded in any year.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional knowledge among its members, offers an annual prize of Twenty-five Dollars in this University, to continue for a period of five years, commencing 1931, to the student who in his Third Year in any one of the six Departments of Engineering has proved himself most deserving as disclosed by the examination results of the year in combination with his activities in the Engineering Society, or with a local branch of another recognized engineering organization. This prize was extended in 1935 for a further period of five years.

CERAMICS SCHOLARSHIP

The Canadian Ceramic Society offers an annual scholarship of the value of Fifty Dollars for a period of ten years commencing 1932, to be known as "The Ceramics Scholarship." The scholarship will be awarded to the student in the Third Year in the Department of Metallurgical Engineering enrolled in the Ceramics Option, who has obtained the best academic standing. An award will not necessarily be made in any year.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize to the value of Twenty-five Dollars, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year Student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who

obtain standing without condition at the Annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. In any year in which no award is made, the income from the prize for that year will be available for a second award in any subsequent year.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available to students in this Department, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award will be made to another eligible student.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA MEDAL

The Royal Architectural Institute of Canada has presented a medal to be awarded annually to a member of the graduating class in the School of Architecture, who having completed the requirements for the degree, has obtained high standing throughout his course and gives promise of being an architect of distinction after graduation. The person to whom the award is made must be a British subject; he must have completed the entire course in Architecture in the School of Architecture of the University of Toronto, except in the case of a graduate of the Royal Military College who shall have completed at least the Third, Fourth and Fifth Years in the School; he must have obtained high standing throughout his course, particularly in Architectural Design, and his character, personality and intellect must be such as to indicate that in the practice of his profession, he may be expected to attain distinction. No award will be made in any Session in which the Council of the Faculty of Applied Science and Engineering so recommends.

THE RHODES SCHOLARSHIP

The Rhodes Trustees offer two scholarships for award annually in the Province of Ontario, each of the value of £400 a year and tenable ordinarily for three years.

Each candidate must be a British subject with at least five years domicile in Canada, and unmarried; he must have passed his nineteenth but not his twenty-fifth birthday on October 1st of the year for which he is elected; and he must have reached such a stage in his course at the University that he will have completed at least two years.

In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments;
(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship;
(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his fellows;
(4) Physical vigour, as shown by fondness for and success in outdoor sports.

Forms of application and full information regarding these scholarships may be obtained from D. R. Michener, Esq., 372 Bay Street, Toronto 2, Secretary of the Committee of Selection for the Province of Ontario.

UBUKATA FUND

The S. Ubakata Fund, the gift of the late S. Ubakata, of the value of $10,000, provides for the establishment of prizes, medals, scholarships and loans for which Japanese students of all faculties and colleges may be eligible. Application must be made to the University Registrar on or before December 1st.

F. W. JARVIS BURSARY

The F. W. Jarvis Bursary, the gift of A. H. Jarvis, Esq., of Ottawa, brother of F. W. Jarvis, of the value of $50, to be awarded under the following conditions:

1. The bursary is open only to former students of Ottawa Collegiate Institute (Lisgar Street), who without some such assistance may not be able to carry on their academic courses.

2. It may be awarded at matriculation or in any year of an undergraduate course in any faculty of the University.

3. It may be held in successive years by the same student and is tenable with any scholarship awarded by the University or federated college.

4. It shall be awarded on the recommendation of a committee of award consisting of the President of the University, the Principal of Ottawa Collegiate Institute and the donor. Application must be made to the University Registrar on or before May 15th.

UNIVERSITY OF TORONTO WAR MEMORIAL SCHOLARSHIPS

Four scholarships, each of the value of Two Hundred Dollars, have been established by the Alumni Federation of the University from the War Memorial Fund to be awarded to students in the Faculties of Applied Science and Engineering, and Forestry.

The general basis on which scholarships may be awarded shall be as follows: (*a*) standing in course of studies. (*b*) need of assistance. (*c*) merit as shown in extra-academic activities—executive, literary, dramatic, athletic, etc. (*d*) relationship, if any, to active service during the War.

Information regarding these scholarships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., to whom application must be made not later than April 15th.

UNIVERSITY OF TORONTO WAR MEMORIAL FELLOWSHIPS

Two Fellowships of the value of $500 each, in the School of Graduate Studies of the University have been established by the Alumni Federation of the University of Toronto from the War Memorial Fund, to be awarded to graduates of any approved university in the Dominion of Canada enrolled, or intending to enrol in the School of Graduate Studies, for the purpose of proceeding to a degree in any department of the University of Toronto.

The general basis of award is as follows: (*a*) standing at graduation or in previous year of postgraduate work. (*b*) such other general qualifications of merit as may commend themselves to the committee, including relationship (if any) to active service during the War.

Information regarding these fellowships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., Toronto, to whom applications, accompanied by an official statement of undergraduate standing, should be made before April 15th.

(For the session 1937-1938 only one of these fellowships will be awarded.)

MCCHARLES PRIZE

This prize was established in connection with the bequest of the late Æneas McCharles of Provincial Government bonds of the value of $10,000, and is awarded on the following terms and conditions, namely, that the interest therefrom shall be given from time to time, but not necessarily every year, like the Nobel prizes in a small way: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any

Canadian in scientific research in any useful practical line. The following conditions, as passed by the Board of Governors, determine the method of award:—

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000.00) in money.

(3) The term "Canadian" for the purpose of this award shall mean any person Canadian born who has not renounced British allegiance; and for the purpose of the award in the first of the three cases provided for by the bequest, domicile in Canada shall be an essential condition.

(4) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(5) No prize shall be awarded for any discovery or invention unless the same shall have been proved to the satisfaction of the awarding body, to possess the special practical merit indicated by the terms of the bequest.

(6) The order of priority in which the three cases stand in the wording of the bequest shall be observed in making the award; that is, the award shall go *caeteris paribus* to the inventor of methods of smelting Canadian ores; and, failing such inventions, to the inventor of methods for lessening the dangers attendant upon the use of electricity; and only in the third event, if no inventors of sufficient merit in the field of metallurgy and electricity present themselves, to the inventor distinguished in the general field of useful scientific research.

(7) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIP

The Royal Commissioners for the Exhibition of 1851 have invited the University of Toronto to recommend annually one or more candidates in order of merit for science research scholarships, each of the value of £250 per annum and ordinarily tenable for two years.

Each candidate recommended must be a British subject, and under twenty-six years of age except in very special circumstances; he must have been a student of science in a university institution for a period of not less than three years and must have spent one full academic year at this University ending not more than twelve months prior to the date of recommendation.

The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

The scholar will be required to devote his whole time to research in some branch of pure or applied science at an institution in the United Kingdom or abroad, selected with the approval of the Commissioners.

The following are the departments of the University ,the students of which are eligible to apply for these scholarships:—1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geology; 13. Mineralogy; 14. Physics; 15. Physiology; 16. Zoology.

A student shall not be deemed to be ineligible because of his being on the staff of the University, if he has not been in receipt of a salary of more than $800 per annum and the nominating board may, at its discretion, recommend candidates who have been in receipt of larger salaries provided that all other conditions are fulfilled.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nominating board consists of the following seven members appointed by the Senate:—the Chancellor, the President, Chancellor Wallace, the Honourable Mr. Justice Masten, Professor DeLury, Dr. C. S. MacInnes, and Dean Brett, and the Board shall have power to call to its aid as assessor any member of the teaching staff.

Applications for these scholarships must be submitted not later than April 15th to the University Registrar from whom copies may be obtained of the general regulations of the Commissioners governing the award and tenure of the scholarship.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering to be known as The Nipissing Mining Company Research Fellowship, of the annual value of Eleven Hundred Dollars.

This Fellowship is open to the graduates of any University.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller of the class of 1893 the "Elizabeth Speller Memorial Fund" has been established, the annual income from which is available for loans to worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary.

SECTION XII. LIBRARIES AND LABORATORY EQUIPMENT

LIBRARIES

THE UNIVERSITY LIBRARY

The University Library building is situated on the east side of the lawn that lies to the south of University College. It contains reading-rooms for men and for women, a law reading-room, and a medical reasing-room, besides departmental studies which may be used as study rooms for honour students in the various depratments in which the professors hold seminary courses, and private studies intended for advanced students engaged in research work.

The University Library building is opened at 8.45 every morning, and remains open until 10 o'clock in the evening, during the academic term. Books in ordinary use may not be taken out of the Library building or from the reserved book reading-rooms during the day-time, but are lent for the night toward 3 p.m., to be returned the following morning not later than 10 o'clock. Books not in general demand, may on application be borrowed for a longer period.

DEPARTMENTAL LIBRARIES

Periodicals and other literature in the University Library of special interest to the students of this faculty have been housed in the Electrical, Engineering, Mechanical and Mining Buildings for convenient reference.

These departmental libraries are situated as follows:

Applied Physics	Room 22, Engineering Bldg.
Architecture	Room 37, Engineering Bldg.
Chemical Engineering	Room 53½ Mining Bldg.
Civil Engineering	Room 25, Electrical Bldg.
	Room 22, Engineering Bldg.
Electrical Engineering	Room 25, Electrical Bldg.
Mechanical Engineering	Room 17, Mechanical Bldg.
Metallurgical Engineering	Room 37, Mining Bldg.
Mining Engineering	Room 314, Mill Bldg.

AERODYNAMIC LABORATORY

The Aerodynamic Laboratory is fully equipped with an improved 4-ft. Royal Aircraft Establishment type wind channel, aerodynamic balance, micromanometers and other necessary instruments.

Air speeds of 80 feet per second can be secured in a stream of great steadiness and uniformity and higher speeds with some sacrifice in steadiness.

The work done in the Laboratory includes the investigation of problems in aerodynamics, tests of air craft components, and complete machines, rating of meters, ventilators, radiators, etc., and the study of the effect of wind pressure on structures, chimneys, etc.

ASSAYING LABORATORIES

The Fire Assaying Laboratories are situated on the top floor of the new Mill Building. The East and West laboratories are identical and consist of preparation, furnace and balance rooms. Between and common to these is a supply room and another for the wet work in connection with the subject. The arrangement is such as to allow a natural flow of operations from preparation of the product to be assayed to the final weighing.

The preparation rooms are equipped with a Sturtevant crusher, McCool pulverizer, buck boards, samplers, cupel machines and screens. A special laboratory sampler has been constructed, for the purpose of giving samples for the students' assays, of indisputable similarity, thus confining variations in results to their work.

The furnace rooms have six Fletcher-Russell Perfected gas furnaces supported on concrete pouring tables, and two Denver Fire Clay oil-burning type. Each working table has its own balance, also a locker and drawers for fluxes, weights and tools.

The balance rooms face the north light. Protection from dust and fumes is afforded by double entrance doors. The bead balances are supported on a concrete slab resting on brick piers insulated by cork to absorb vibration. The balances are illustrative of the types met in practice, the following makers being represented—Ainsworth, Becker, Heusser, Keller, Oertling, Thompson and Voland. Some have a sensitivity of $\frac{1}{500}$ milligram.

Realizing the importance of storing fluxes, free from contamination, these are kept in an inner storeroom off the main supply room which houses clayware, and general stores. Remote from here is the ore storage room containing a large number of ores, matte, bullion and alloys, obtained chiefly from typical mining districts and metallurgical plants.

Undergraduate research is carried on in the Thesis room. This has coal and gas furnaces. Other apparatus is supplied to suit the investigations undertaken. A study room is always available.

Contiguous to the staff rooms are two equipped for research and the determinations required for instructional purposes. A Hoskins electric resistance furnace is installed, also a Leeds-Northrup controller and recorder. Other equipment includes optical, resistance and thermocouple pyrometers, microscopes, drying oven, Guess-Haultain stationary electrolytic outfit, King rotating electrolytic apparatus, and bullion rolls.

CEMENT TESTING LABORATORY

This laboratory is fitted with all the ordinary moulds, sieves, balances, burettes, steaming and drying tanks, tables, and other appliances necessary in making the usual physical tests of a Portland cement. It is also supplied with completely equipped cabinets for individual work. In addition there are the following:

A 2,000 lb. Riehlé shot machine for tension.

A 2,000 lb. Fairbanks shot machine for tension.

A 1,000 lb. Olsen automatic shot machine fitted for tests in either tension or cross breaking.

An Olsen soapstone moist closet.

CHEMICAL LABORATORIES

The Chemical Laboratories are situated in the western half of the Chemistry and Mining building, in the basement, first and second floors. The rooms are large and well lighted, and are supplied with the usual modern equipment.

Instruction in general chemistry and in elementary quantitative analysis is given in a large laboratory on the second floor, accommodating 84 students, each working place being supplied with water, gas and fume cupboard. Two adjoining laboratories, with provision for 50 students, are set aside for the use of the Second Year in the course in Chemical Engineering, while two other laboratories, with 36 and 48 working places, are used jointly by the Third Year in Chemical Engineering and by other students in Mining and Metallurgy, and also by the Department of Chemistry, Faculty of Arts. Fourth Year students in Chemical Engineering are accommodated in a laboratory which has provision for 20 men engaged in research work. Each of these laboratories has its own balance room adjoining, furnished with instruments from the best makers and adapted to the particular objects in view.

In addition there are seven small rooms set apart for research, a room for gas analysis and a specially constructed fireproof laboratory for combustion and bomb furnaces. Each of these is well equipped and offers excellent facilities for the prosecution of research, as well as for work of a technical character.

ELECTRICAL LABORATORIES

The Department of Electrical Engineering is located in the Electrical Building. The accommodation includes quarters for staff, library, lecture rooms, laboratories, stores, and shop for repairs and construction.

Services.—Three-wire direct-current, 110 kw., from the University power house, automatically regulated at our end for constant voltage of desired value at our main switchboard. Three-phase, 60 cycles, 60 k.v.a., 115 volts, automatically regulated as to voltage and frequency. Three-

phase, 25 cycles, 30 k.v.a., automatically regulated as to voltage and frequency. Every laboratory has all three services available at convenient places. There are three main boards, one for each floor. A system of special trunk lines between boards, and tree systems on each floor, enable easy arrangement of any desired special connections from any laboratory to any other.

Alternating current laboratory.—Area 26 x 110 ft., service sets 60 and 25 cycles, Tirrill regulators. Two 60-cycle and two 25-cycle, 15 k.v.a. motor-generator sets; converters: various motors, squirrel cage and wound rotor induction types, repulsion and other single-phase types, unity power factor motor, polyphase motor with variable speed shunt characteristics and speed range of 4 to 1; transformers, single and three-phase; constant-current transformers with load of series arc lamps; lamp racks, reactors, condensers, brakes, etc.; oscillographs; indicating, graphic, recording, and demand meters of the best makes; all arranged to facilitate a very general line of experimental work.

Direct current laboratory.—40 kw. 230 to 115 volt motor generator set with Tirrill regulator for special tests. Numerous 5 kw. to 10 kw. motor-generator sets; shunt, series, compound motors; special interpole machines; loading racks, dynamometers, rheostats, numerous meters of first quality, etc., for any sort of study.

Measurements Laboratory.—26 x 110 ft. Fitted with very flexible storage battery service which can be connected to any desired working place; d.c. three-wire service, also 60 and 25-cycle three-phase everywhere; galvanometers, resistance boxes, bridges, shunts, potentiometers, standard cells, bond testers, ductor, megger, apparatus for measuring low resistances, artificial lines for fault measurements, condensers, inductances, rails, cables, voltmeters, ammeters, wattmeters, dynamometers, etc., for general work on a great variety of measurements.

High voltage laboratory.—For various lines of study with voltages up to 200,000 volts. Flexible and safe provision for control.

Materials laboratories.—One specially fitted for general work on conducting materials, one for magnetic materials, one for dielectric materials.

Communication laboratory.—Adapted for the measurement of various quantities of interest in this work, including the strength of incoming signals. One single conductor aerial 1,000 ft. long, one multi-conductor aerial 120 ft. long.

Standardizing laboratories.—One students' calibration room for direct-current meters, another for alternating-current meters. A standards room, constant temperature, for master standards of voltage, resistance, current, power, etc.

Research laboratories.—Four rooms set apart for this work, in combination with facilities of the other laboratories.

Design laboratory.—Arranged for calculation work on apparatus selected to illustrate essential principles.

ELECTROCHEMICAL LABORATORIES

The Electrochemical laboratories, which are situated in the Mining Building, are provided with special facilities for electrolytic work, including a large storage battery and electroplating dynamo with tanks as well as a good set of apparatus and electrical measuring instruments. The experimental work on electric furnaces is carried out in a large furnace room in the basement, occupied jointly by this Department and the Department of Metallurgy. The equipment for this purpose comprises a 120 KW, 220 volt supply of direct current from the main power house through a switchboard, rheostats, circuit-breaker and instruments to a set of distributing bus-bars, and a 200 KV-a transformer stepping down from 2200 volts to 30-120 volts in 3 and 6 volt steps, which supplies alternating current at 25 cycles. There is a complete set of A.C. instruments, circuit-breakers, oil-switches, relays, automatic regulating winches, etc., and a Northrup high frequency furnace with its transformer is also installed.

APPLIED PHYSICS LABORATORIES

The Applied Physics laboratories, situated in the Engineering Building, are equipped as follows:

The Photometric Laboratory is equipped with precision and portable photometers for the measurement of candle-power, illumination, and brightness, integrating spheres for determining the luminous output and efficiency of lamps and lunmiaires, and colorimeters, spectro-photometers and flicker photometers for the measurement of colour. Standards of candle power, luminous flux and colour temperature are maintained and a 132 volt storage battery with all electrical controls and meters necessary for precise photometry are provided.

The Illumination Design Laboratory is equipped for demonstrating and measuring the performance of lighting installations.

The Optics Laboratory is equipped with optical benches, etc., for the testing of lenses and examples of various optical instruments for instruction in their theory and applications.

The Photographic Laboratory is equipped with cameras, darkrooms and accessories for practical work in photography, and with sensitometers, spectrographs and densitometers for the testing of photographic materials. A Zeiss phototheodolite, stereoscope, stereo-comparator and plotting apparatus are provided for instruction in photographic surveying.

The Acoustical Laboratory is equipped with the ordinary apparatus for illustrating the elementary laws of acoustics, that is, forks, pipes, conometers, etc. There are also two rooms intended for work in sound transmission and absorption. The equipment of these consists of a four octave organ for the production of sounds of constant intensity and a microphone and amplifier circuit for reception. There is also an oscillator and dynamic loud apeaker as an alternative to the organ.

The Heat and Hydrostatics Laboratory is equipped for experiments on thermometry, calorimetry, thermal expansion, heat transmission, etc., and for work with hydrometers, manometers, barometers and the determination of specific gravity.

GEOLOGICAL AND MINERALOGICAL LABORATORIES

In the Mining building on College Street the University possesses a modern laboratory for Geology and Mineralogy.

Courses are given in laboratory work, especially in personal examination of type sets of rocks, fossils, minerals and crystal models. These laboratory exercises serve to illustrate the introductory didactic instruction.

For the encouragement of pure crystallography the laboratories are supplied with goniometers of the various types, crystal models, appliances for the cutting of oriented crystal sections and for the physical examination of the same. Practical petrography is carried on in rooms provided with type sets of rocks, both macroscopic and microscopic. Advanced students are taught to make thin sections of rocks and fossils and to study them microscopically. For students in Mining a laboratory course in the interpretation of geological maps and sections is provided. Typical mining regions are studied in detail and an opportunity is afforded for the examination of specimens illustrating economic geology.

The laboratory for the preparation of thin sections of rocks, minerals and fossils is provided with electric diamond saws and grinding appliances for the various types of work incidental to the preparation of thin sections and museum material.

A room is also provided for advanced work in cartography and geological surveying.

The departments possess 40 petrological microscopes and 10 of other types, so that it is now possible to provide advanced students with instruments and sets of thin sections for their own special use. The blowpipe laboratory contains 156 lockers, especially designed for apparatus for students. Provision is made for the study of opaque minerals in reflected ight.

HIGHWAY LABORATORY

ROAD METALS AND SUBGRADE SOILS

This laboratory is equipped for carrying out investigations in the various materials employed in highway construction and maintenance, and comprises the following:

A Page impact machine for testing the toughness of road materials.

A diamond core drill for preparing specimens for the toughness test.

A Deval abrasion machine for testing the resistance to wear of road materials.

A cementation testing apparatus (Page type) for determining cement in properties of road materials.

A jaw crusher (Mitchell type) for crushing rock for various tests.

A power driven agitator with sieves for the mechanical analysis of sand, gravel and crushed rock.

A Dorry hardness testing machine for determining the hardness of rock used in road construction.

A Riehlé standard brick-rattler.

A mechanical centrifuge for determining moisture equivalent of soils and apparatus for determining volumetric changes, capillary moisture and other properties of subsoils of interest to the highway engineer.

A Hamilton Beach dispersing machine and a Bouyoucos hydrometer for determining soil analysis.

BITUMENS

This laboratory is designed for the investigation of the physical rather than the chemical properties of bitumens used in road construction and maintenance. The equipment consists of an extractor for separating bitumens and aggregates, an Engler viscosimeter, a penetration apparatus as well as appliances for determining melting point, volatilization, specific gravity, ductility, etc,

HYDRAULIC LABORATORY

The hydraulic laboratory occupies two floors each 40 feet x 112 feet, which are well lighted by large windows on the side and end.

The water for the experimental work is pumped through the various pieces of apparatus from a well by means of two turbine pumping units, both of which are driven by a Belliss and Morcom compound engine of 125 h.p. running at a speed of 525 revs. per minute. Both engine and pumps have been installed with a view to using them in experimental work as well as for supply of water for other apparatus used in the laboratory.

The pumping units are capable of delivering one cubic foot of water per second against heads of 250 feet and 300 feet respectively. These units are designed and connected up so that they may be run in series giving the above discharge at 550 feet head, or they may be run in parallel giving double the discharge at a lower head. Each pumping unit consists of two two-stage pumps mounted on a common base and driven by a single pulley, and the construction and piping are such that each two-stage pump may be driven separately or that all may be driven at once, discharging separately one cubic foot per second at about 125 feet head through each of four independent pipes, or else the pumps may be run in series or in parallel. The scheme is thus well adapted to laboratory work, and under the heads used on reaction turbines about six cubic feet per second may be obtained.

In addition to this there is an electrically driven pump capable of delivering six cubic feet per second at a head of sixty-five feet and which is most helpful in turbine testing. Attention is called to the special turbine testing flume described below.

The laboratory further contains a large vertical steel tank $5\frac{1}{2}$ feet diameter by 34 feet, with arrangements for the attachment of nozzles and other mouthpieces, etc. Connections are also arranged for reaction turbines, the tank acting as a reservoir.

The discharge from the turbines or nozzles is measured in a weir tank nearly 6 feet wide and 21 feet long, containing a contracted weir $4\frac{1}{2}$ feet wide. This weir may be calibrated by two weighing tanks, each having a capacity of about 240 cubic feet.

There are three reaction turbines and two impulse wheels all ready for experiment, the power being measured by brakes and the water by weir or orifices. Amongst the reaction turbines may be mentioned the one designed and built by Escher Wyss & Co., specially for the laboratory.

A new and specially designed turbine testing flume has recently been added to the laboratory, the machinery for which has been largely furnished through the kindness of the Dominion Engineering Works, Montreal, and Wm. Cramp and Sons, Philadelphia. This flume is supplied with water by a Moody spiral pump of twelve cubic feet per second capacity and at present there are two turbines, one of the propeller type, and also two special draft tubes and more will be added. This provides an excellent opportunity for experiment and research.

A Kaplan turbine has also been installed.

Smaller orifice and weir tanks, each about 3 x 3 x 12 feet with necessary measuring tanks, are arranged for instruction in coefficients of various kinds and practice with weirs and orifices.

A Venturi meter and other meters, also an hydraulic ram and similar devices are available for testing, and good facilities have been arranged for investigating friction and other properties of pipes and fire hose.

For special investigations on turbine and centrifugal pumps, other pumps in addition to those already described have been arranged.

The basement of the laboratory contains an open trough 5 feet wide, about 110 feet long, with a large weir at one end. It is intended to use this trough for experiments on the flow in open channels, for measurements of large discharges by means of the weir, and for experiments with current meters and Pilot tubes.

Numerous pieces of smaller apparatus, together with all instruments required, have also been provided, and the laboratory equipment is believed to be very complete. A glass trough 30 feet long has been added to the equipment.

MECHANICS OF MATERIALS LABORATORY

This laboratory is available for the scientific and commercial testing of materials of construction such as iron, steel, timber, concrete and masonry.

It is supplied with the following:

A 200 ton, three-screw power testing machine, built by Riehlé Bros., Philadelphia. It will make tests in tension, compression, shear and cross-bending, and will take posts 10 feet long and beams of 16 feet in span.

A Riehlé 100 ton screw power universal testing machine, taking posts 12 feet long and beams of 18 ft. span.

A Riehlé 10-ton screw power universal testing machine.

A Riehlé 50-ton screw power universal testing machine.

A 15-ton single lever-machine, built by J. Buckton & Co., Leeds, England.

A torsion machine, built by Tinius Olsen & Co., Philadelphia, for testing the strength and elasticity of shafting. This machine will accommodate specimens up to 16 feet in length and 2 inches in diameter.

A hand power torsion machine of simple mechanical design for the testing of short shafts of a maximum diameter of one inch.

A Riehlé transverse testing machine of 5,000 pounds capacity, adapted to specimens up to 48 inches in length.

A Riehlé compressometer, with spherical seat attachment for the adjustment of specimens having slightly non-parallel faces. This compressometer will receive specimens up to 10 inches in length.

A set of Riehlé proving levers with standard weights for calibrating testing machines.

An Amsler calibrating box of 60,000 lb. capacity for calibrating testing machines.

An Olsen compression micrometer of standard type.

A 20,000 pound Olsen, hand power, wire testing machine, specially fitted for testing wooden columns with both fixed and pivoted ends.

An Olsen combined tension and cantilever type impact testing machine.

An Olsen, 20,000 pound, hand-power testing machine especially adapted for testing long columns.

An Olsen, 200 pound capacity, textile testing machine.

A Berry strain-gauge for spans of 2 inches and 8 inches and an Olsen strain gauge of the same range.

A Nalder dividing engine. This may be used either for the precise division of scales or for the calibration of instruments intended for refined measurements.

A Brinell hardness testing machine.

An Olsen Brinell proving ring, 3,000 kg. capacity, for checking the Brinell hardness tester.

A Firth hardometer with diamond and ball attachments for hardness testing.

A Shore scleroscope for testing hardness.

A Fereday-Palmer stress recorder by T. Cooke & Sons, Ltd., London.

Four Beggs deformeter gauges with necessary plugs and accessories for investigating stresses in structures by means of models.

A large number of extensometers of the usual degree of precision. These include the Bauschinger, Martens, Unwin, Ames, Riehlé, Johnson, Henning

(recording), Huggenberger and other types. In addition there are the usual scales, micrometers, telescopes and reflectors, voltmeters for the determination of metallic contact, and such other appliances as are necessary in the making of precise measurements.

The shop is equipped with a number of high-class machine tools specially fitted for reducing the specimens to the requisite shapes and dimensions with a minimum of hand labour. It is also supplied with the necessary appliances for making ordinary repairs and for making apparatus for special experiment and original investigation.

METALLURGICAL LABORATORIES

This laboratory, in the East end of the Mining Building, occupies about 3,600 sq. ft. on the basement floor and the same space immediately above on the ground floor. The basement floor is divided into one large furnace room, a small hydrometallurgical room and two store-rooms. The furnace room contains a motor driven Connersville blower, several gas fired furnaces, two small blast furnaces, and a small 6 hearth Wedge roasting furnace. The larger electric furnaces of the Department of Electrochemistry are in this room. Some are supplied with direct current, others with A.C. from a 200 K.V.A. transformer. A system of flues, with hoods over all the furnaces, leads through a Cottrell precipitator of the Rathbun type taking current at 50,000 volts, to a stack through which gases are pulled by a fan in the attic.

The hydro-metallurgical room in addition to apparatus for leaching tests contains several natural draft furnaces, a large Hoskins resistance furnace and a 113 lb. drop hammer. There are also tanks for electrolytic refining and precipitation of metals.

The upper floor is divided into laboratories, store rooms and offices. The laboratories are: 1. Metallurgical analysis; 2. Heating treatment and pyrometry; 3. Grinding, polishing and etching; 4. Metallographic room with an adjoining dark room.

In the laboratory for metallurgical analysis the student is given some training in mill and smelter methods of analysis. It is well equipped for this work.

In the heat treatment and pyrometry laboratory are a number of tube furnaces of different sizes, a Leeds & Northrup transformation point indicator with furnace, double thermocouple and twin galvanometer, a Leeds & Northrup potentiometer pyrometer, a disappearing filament pyrometer, and many thermocouples for use with galvanometer or potentiometer. For grinding and polishing there is provided two motor driven emery wheels and a set of 3 motor driven horizontal polishing plates.

The Metallographic room is equipped with the lastest type Bausch & Lomb horizontal inverted microscope type of photo micrographic apparatus, an older and horizontal photo micrographic instrument made by Pellin, Paris; two vertical photo micrographic instruments and three other metallographic microscopes.

There are also a Pellin instrument for the determination of critical points by photography according to the Saladin method, and a Leeds & Northrup type "K" precision potentiometer, which is also used for the determination of critical points.

The laboratory has a Rockwell hardness testing machine, and a wire drawing bench.

The Ceramic equipment includes:

A dry pan and a vertical pug mill.

A small dry press.

A plunger machine with tile and hollow ware dies.

An Abbé six jar ball mill.

A recuperative down draft clay testing furnace of brick construction.

An oil fired muffle decorating kiln.

A small Seger test furnace.

A high temperature oxygen acetylene furnace.

A high temperature electric muffle furnace with a temperature range up to 1700°C.

Standard screens, volumeters, elutriation apparatus driers and such sundries as are necessary for clay testing.

METROLOGICAL LABORATORY

The department of surveying and geodesy is provided with all the ordinary field instruments, such as transits, levels, compasses, micrometers, sextants, planimeters, plane tables, tapes, chains, etc., with which is carried on the instruction in practical field operations as detailed elsewhere.

A small laboratory is also established in the basement of the observatory described below, containing the necessary instruments for the refined measurements of geodetic surveying; as, a standard yard and metre, a Rogers 10-foot comparator, an invar base measuring apparatus, a Kater's pendulum with vacuum chamber, a level trier, micrometer microscopes, etc.

The geodetic observatory in connection with this department is used for the instruction of students of the Fourth Year in taking observations for time, latitude, longitude, and azimuth by the precise methods used in connection with a geodetic survey. It contains a 10-inch theodolite and zenith telescope by Troughton & Simms; an astronomical transit instrument and an 8-inch theodolite by Cooke; two electro-chronographs; a Howard astronomical clock; a Dent sideral clock; a Dent sideral break-circuit chronometer; a wireless receiving instrument; arithmometers, etc.

MINING AND ORE DRESSING LABORATORIES

During 1931 the building containing these laboratories was entirely rebuilt and greatly enlarged. The new building is 72 ft. x 100 ft., and is four storeys high with a basement under half of it. The top floor and part of the second are occupied by the assaying laboratories. The rest of the

building is given up to the ore dressing and mining laboratories, the commodious library and study rooms, lavatory and shower baths, rooms for the staff, two rooms for research in ore dressing, a model and map room and storerooms. The main ore dressing laboratory, 72 ft. x 53 ft. x 22 ft. high, is equipped with the old five stamp battery with amalgamation plates, Wilfley table, Deister Plato table, Deister slime table, an old-fashioned buddle and classifiers. Parallel with the stamp mill is a ball mill 30 in. x 24 in., which can be used alternatively with the stamps in connection with the concentrating tables. At one side of this main laboratory is apparatus representing the complete flow-sheet of a modern concentrator designed for continuous operation at the rate of 50 to 100 lbs. per hour. This plant consists of feeders, two rod mills and a ball mill each 18 in. x 12 in., with classifiers, two Wilfley tables, a Dorr type thickener, a six-cell Fahrenwald Sub A flotation unit, a conditioner, a small pilot Wilfley table, and a Genter thickener. Another laboratory, 70 ft. x 25 ft., is set aside for batch work and contains a variety of flotation machines, small ball and rod mills, apparatus for cyanide tests and for tests in magnetic concentration. Other rooms are set apart for hand screening, microscopes, balances, a chemical room and a room for roasting and other high temperature testing of ores in connection with ore dressing.

The crushing laboratory contains a Hatfield gyratory crusher, a set of rolls 16 in. x 12 in., a small Dodge crusher, two sets of miniature rolls, two disc grinders, and a dry screening machine of the Feraris type. Adjoining this room is a large room for practising sampling methods. The mining laboratory is equipped with an Ingersoll-Rand type E.R.-1 compressor and a variety of air drills representing the development of this machine, blocks of synthetic ore for practising sampling, forges for sharpening steel and moils, and shortly to be completed a laboratory for the study of ventilation problems, air conditioning, dust counts, etc. In the main basement are bins for the accommodation of a large variety of ores from the different mining districts.

MUSEUM

The ROYAL ONTARIO MUSEUM, with exhibits in Archaeology, Geology, Mineralogy, Palaeontology and Zoology, is situated at the southwest corner of Bloor Street and Queen's Park.

Students of the University in all departments are recommended to avail themselves of the privileges of the Museum, which, although under separate control, is intimately connected with the work of the University.

The Museum is open on all week days from 10 a.m. to 5 p.m., and on Sundays from 2 p.m. to 5 p.m. The admission is free to the public on Tuesday, Thursday, Saturday and Sunday. On other days an admission fee of fifteen cents is charged.

By a resolution of the Board of Trustees all regular students of the University may be admitted free on all days of the week by presenting their card of registration.

ONTARIO BOARD OF HEALTH LABORATORY

Through the courtesy of the Secretary of the Provincial Board of Health for Ontario the facilities of the excellently equipped laboratory which the Board maintains at Stanley Park have, with certain conditions, been placed at the service of the University for the investigation of problems of interest to the sanitarian and the sanitary engineer. The equipment consists of various types of sewage sedimentation tank, sewage filter, sewage measuring devices, aerators, sterilizing appliances and a complete and representative plant intended for the filtration and sterilization of water by practically all known methods.

PHOTOGRAPHIC AND PROJECTION LABORATORIES

The Photographic Laboratory contains a supply of small cameras for the use of students, enlarging cameras, printers, blue printing machine and the necessary dark rooms.

This Department also carries on a photographic and projection service for all Faculties and Departments of the University. The equipment for this work consists of cameras for making photographs up to full plate size, enlargers, photo-micrographic apparatus, motion picture cameras for both gross and micro work, with the necessary developing and printing machines, a rotary blue print machine, a photostat, etc.

For projection service there is a motion picture projector and a number of projection lanterns for service in any University Building.

THERMODYNAMICS AND MECHANICAL LABORATORY

This laboratory is included in a large, well-equipped building for the accommodation of the steam, gas, mechanical and hydraulic equipment. A more complete description of the laboratories has been published elsewhere, so that the present description is only intended to give the main features.

The part of the building set apart for thermodynamics and other mechanical work is the ground floor of a room 60 ft. x 155 ft. This room is lighted entirely from the roof in a very perfect way. A part of the space 40 ft. wide running the entire length of 155 feet is served by a 3 ton travelling crane and contains the following equipment:

50 h.p. Brown engine with separate jackets on both heads and barrel of cylinder.

Two-stage Rand air compressor having compound steam cylinders, each fitted with Meyer cut-off gear. The low pressure air cylinder has Corliss inlet gear.

30 h.p. high-speed Leonard tandem compound engine with shaft governor.

15 h.p. high-speed McEwen engine.

40 h.p. Uniflow engine.

25 h.p. General Electric steam turbine.

Two 15 h.p. Leonard engines with different types of valves, which are used for valve setting.

Centrifugal air compressor.

There are also two surface condensers with air pumps so arranged that any engine in the laboratory may be made to exhaust into the atmosphere through an open heater or into one of the condensers, the change from one arrangement to the other being accomplished in a few minutes without the aid of valves.

The laboratory further contains:

A 3 ton York refrigerating machine with tanks.

An Amsler transmission dynamometer.

Apparatus for testing injectors and steam pumps.

Hot blast heating equipment.

Numerous other pieces of apparatus and instruments.

The work on internal combustion engines and producers is performed on the following:

14 h.p. National gas engine arranged for various compressions and points of ignition.

25 h.p. horizontal Diesel engine made by Ruston and Hornsby, specially arranged for testing.

25 h.p. Allen semi-Diesel engine.

25 h.p. tractor gasoline engine.

Six cylinder Chevrolet automobile engine.

200 h.p. Sprague electric dynamometer.

Various accessories to above machines

Steam for the laboratory is supplied by two 50 h.p. and one 100 h.p. Babcock and Wilcox boilers, the latter having an internal superheater. These boilers are located in a separate boiler room. They are used for experimental work only and are fitted up for testing. The gases pass up through two independent chimneys, and these have been arranged so that the draft and other conditions in the chimney at any point of its height may be examined.

In smaller work-rooms off the main laboratory are placed belt and oil-testing machines, apparatus for testing the efficiency of gears and machines, and for experiments in the balancing of machinery.

SECTION XIII. DISCIPLINE

1. (a) There is vested in the Council of each federated university or college, and of each faculty, disciplinary jurisdiction over and entire responsibility for the conduct of their students in respect of all matters arising or occurring in or upon their respective buildings and grounds, including residences.

(b) Disciplinary jurisdiction in all other cases as respects all students is vested in the Caput.

(c) The Students' Administrative Council, in the discharge of all duties entrusted to it, will be suported in the due discharge of those duties by the disciplinary power of the Caput.

2. No student will be allowed to continue in attendance, whose presence is deemed by the Council of his college or faculty to be prejudicial to the interests of the University.

3. Students proceeding regularly to the degree are required to attend the courses of instruction and the examinations in all subjects prescribed for students of their respective standing, and no student will be permitted to remain in the University who persistently neglects academic work.

4. Unless special permission is granted by the Council of the faculty concerned, a student will not be permitted further registration in the University if, at the end of two sessions spent in the same year of the faculty in which he is registered, he has failed to obtain the standing necessary to qualify him for registration in the succeeding year of the faculty. An appeal from the decision of the Faculty Council may be made to the Senate.

5. All interference on the part of any student with the personal liberty of another by arresting him, or summoning him to appear before any tribunal of students, or otherwise subjecting him to any indignity or personal violence, is forbidden by the Caput and by the Councils of the colleges and faculties.

6. No initiation ceremony involving personal violence, personal indignity, interference with personal liberty, or destruction of property, may be held by the students of any college or faculty of the University, under the penalty of suspension or expulsion.

7. Any reception of the students of the first year in any college or faculty must be approved by the Council of that college or faculty, but such reception must not involve any infraction of the regulations of the two preceding paragraphs.

8. The organizing of a parade in the streets of the city, or the taking part in such parade without the permission of the authorities of the city on application of the Students' Administrative Council, will be regarded as a breach of discipline.

9. A student who is under suspension, or who has been expelled from a college or faculty or from the University, will not be admitted to the University buildings or grounds.

10. The constitution of every society or association of students in the Faculty of Applied Science and Engineering, and all amendments to any such constitution, must be submitted to and approved by the Council of the Faculty. All programmes of such societies or associations, must before publication, receive the sanction of the Council. Permission to invite any person not a member of a faculty of the University to preside at or address a meeting of any such society or association must be similarly obtained.

11. The name of the University is not to be used in connection with a publication of any kind without the permission of the Caput.

12. Students of any faculty or college on the premises of colleges or faculties other than those in which they are registered shall be subject to the regulations and penalties imposed by the administrative authorities of the premises concerned.

SECTION XIV. HART HOUSE

Hart House, the gift of the Massey Foundation, is so called in memory of Mr. Hart Massey. This House, which is for the use of men only, is far more than a students' club. In its widest interpretation it seeks to provide for all the activities in the undergraduate's life apart from the actual work in the lecture room.

Hart House contains under one roof a dining hall, common-rooms, library, debates room, music room, a small chapel together with rooms for the use of the Student Christian Movement, an art gallery, an arts and crafts room, photographic rooms, billiard room, gymnasia, swimming pool, running track, rifle range, and theatre.

The House is open from 8.00 a.m. to 11.00 p.m. daily and meals are served to students in the Great Hall. Members are entitled to full privileges of all rooms in the building between these hours and the use of the gymnasia, pool, showers and locker rooms until 6.30 p.m. each day except Saturday and Sunday, subject to the regulations of the Athletic Association. On Saturday the pool, together with the rest of the athletic wing, closes at 4.00 p.m.

The Warden is entrusted with the general supervision of the whole House, but the athletic wing is under the direct control of the Athletic Directorate. In great measure the care of the House and its welfare are entrusted to the students themselves. There are a number of committees, most of which consist of ten undergraduates, three senior members, and the Warden. The undergraduates on all these committees are elected annually by the undergraduate members of Hart House and the undergraduate secretaries of six of them (House, Hall, Library, Music, Art, and Debates) sit on the Board of Stewards which, together with certain appointed members, is the governing board of the House and directly responsible to the Board of Governors. Of this Board the Warden is ex-officio Chairman. The Comptroller, the Assistant Comptroller, the Secretary, and the Assistant Secretary of Hart House are responsible for the administration.

All men undergraduates proceeding to a degree in the University are members of Hart House. The annual fee is $12.00 if paid before November 15th; after that date the fee is $14.00. This annual fee includes membership in Hart House and in the Athletic Association for the academic year (September to May). To prevent the use of the building by unauthorized persons every member should carry his registration card and show it on request. Any member wishing to introduce a guest should obtain a card from the Warden's office.

Occasional students are not ordinarily eligible for membership in Hart House, but may make application to the Warden's office for election by the Membership Committee.

Graduate students, graduates resident in Toronto, and out of town graduates are entitled to the full privileges of Hart House when they have been duly elected and have paid the annual fee.

HART HOUSE THEATRE

Hart House Theatre is a Repertory Theatre existing to promote the interests of dramatic art in the widest sense. Its performances are open to members of the University and to the general public. The theatre is operated by a Board of Syndics, who are responsible to the Governors of the University for its administration. It is the policy of the Syndics to permit the rental of the theatre by those recognized dramatic societies within and outside the University which are endeavouring to do serious work.

THE SOLDIERS' TOWER

To commemorate the sacrifice of those graduates and undergraduates of our University who gave their lives in the Great War (1914-1918), the graduates have erected the Soldiers' Tower. Situated at the South-west corner of Hart House, the Tower rises—a symbol of sacrifice—and with its screen forms a majestic link between Hart House and the old Main Building. Beneath the sheltering arches of the screen, the names of the six hundred and eighteen, to whom the memorial pays its proud and affectionate tribute, are cut deep in the stone. Above, in the belfry of the Tower, is a carillon that, as it chimes, weaves a fabric of memories for professors and students who take up the tasks laid down by those who fell.

SECTION XV. STUDENT ORGANIZATIONS

THE STUDENTS' ADMINISTRATIVE COUNCIL

The Students' Administrative Council, is composed of the President and Head of the recognized men and women student organizations in each of the colleges, faculties and departments of the University, as outlined in Article 4 of the Constitution. The Students' Administrative Council assumes responsibility of the publication of The Varsity, Torontonensis and the Students' Hand Book. It represents the students at University functions and on public occasions; and receives and administers all funds accruing from Student Council fees, revenues from publications and such other funds as shall become the property of the Students' Administrative Council; and through its secretaries it organizes such inter-collegiate and University activities as may be of interest to the student body as a whole.

The University band and the symphony orchestra are organized and administered by the Students' Administrative Council. The sale of students' athletic season tickets, official University rings, pins, crests, etc., and orders for official blazers are also in the hands of the Council. In addition, the Council operates an employment bureau for men and women undergraduates for summer, Christmas, and part-time work. It operates a loan fund for men and women undergraduates in the final two years of their courses. Applications for loans must be made to the Students' Administrative Council's office in January of each year.

The annual fee paid by all undergraduates proceeding to a degree, provides for a year's subscription to "The Varsity" and entitles the student to a copy of "Torontonensis" upon graduation, and also to a copy of "The Students' Hand Book" at the beginning of each Michaelmas term. The fee also covers administrative costs of the Students' Administrative Council.

UNIVERSITY OF TORONTO ATHLETIC ASSOCIATION

By the authority of the Board of Governors University athletics for men are under the control of the University of Toronto Athletic Association of which the executive body is the Athletic Directorate consisting of:

- the President of the University,
- two members of the faculty, appointed by the President,
- two graduates, appointed by the Athletic Advisory Board,
- the Medical Director, the Athletic Director and the Financial Secretary (*ex-officio*),
- five undergraduates, elected annually, from the student body,
- an undergraduate representative, appointed by the Men Students' Administrative Council.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with men's athletics, and no men's athletic event can be held in the University without its approval. It has full control and direction of the gymnasium, the swimming pool, the locker rooms, showers and other conveniences in connection with athletics in Hart House, the athletic fields, stadium and ice arena. The Directorate is empowered by the Board of Governors to make the necessary arrangements to effect the carrying out of the University regulations requiring Physical Training for men.

UNIVERSITY OF TORONTO WOMEN'S ATHLETIC ASSOCIATION

By the authority of the Board of Governors University athletics for women are under the control of the University of Toronto Women's Athletic Association of which the executive body is the Women's Athletic Directorate consisting of:

- the President of the University,
- two women members of the faculty, appointed by the President,
- two women graduates, elected by the Women's Athletic Advisory Board,
- the Medical Adviser for Women, the Physical Directress, and the Financial Secretary (*ex-officio*),
- five women undergraduates, elected annually.
- one woman undergraduate, appointed by the Students' Administrative Council.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with women's athletics, and no woman student may participate in any athletic event during the academic year without its permission. The Medical Adviser for Women and the Physical Directress are authorized to arrange for such Physical Training for women as is required by the University.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

The objects of the Engineering Society as set forth in its constitution are:

(*a*) The encouragement of original research in Engineering,

(*b*) The preservation of the results of such research,

(*c*) The dissemination of these results among its members,

(*d*) The cultivation of a spirit of mutual assistance and co-operation among the members of the Society in the preparation for, and in the practice of, the profession of Engineering,

(*e*) To afford an official means of communication between the Student body and the Faculty Council, the University authorities, and the students of other Faculties.

For purposes of organization the Engineering Society consists of a federation of clubs named as follows:

(*a*) The Civil Club of the Engineering Society, composed of undergraduates in Civil Engineering,

(*b*) The Mining and Metallurgical Club of the Engineering Society, composed of the undergraduates in Mining and Metallurgical Engineering,
(*c*) The Mechanical Club of the Engineering Society, composed of the undergraduates in Mechanical Engineering,
(*d*) The Electrical Club of the Engineering Society, composed of the undergraduates in Electrical Engineering,
(*e*) The Architectural Club of the Engineering Society, composed of the undergraduates in Architecture,
(*f*) The Industrial Chemical Club of the Engineering Society, composed of the undergraduates in Chemical Engineering,
(*g*) The Faculty of Applied Science Debating Club, composed of all undergraduates of the Faculty of Applied Science and Engineering.

These Clubs devote themselves to subjects of special interest to their members. Each club holds meetings at regular intervals, when papers are read, and discussions take place in technical subjects.

The Society meets during the academic years (except in April), beginning with the third Monday in October. Addresses are given by prominent men on subjects of general interest.

The Society publishes an annual, called "Transactions", which contains the addresses given at the meetings and an account of the year's activities.

A Supply Department is conducted by the Society on a co-operative plan, through which instruments, draughting supplies, stationery, and other supplies, can be purchased.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

Affiliated with the Engineering Society is the Faculty of Applied Science Athletic Association.

The Athletic Association has full control over all athletic clubs using the name of the Faculty of Applied Science. The Executive Committee has power to suspend anyone from the privileges of membership in the Association for any breach of its regulations, and controls the finances of all athletic clubs in the aforesaid Faculty. The annual membership fee of this Association is two dollars.

No other moneys are collected for the support of athletics in the Faculty of Applied Science without the sanction of the Executive Committee.

STUDENT CHRISTIAN MOVEMENT

The Student Christian Movement in the University of Toronto is part of an international fellowship of students in the colleges and universities of the world.

It is a fellowship, based on the conviction that in Jesus Christ are found the supreme revelation of God and the means to the full realization of life.

It seeks, through study, prayer, and practice, to understand and follow Jesus Christ and to unite in its fellowship all students who share its basic conviction as well as those who wish to test its truth.

Some of the means employed by the Movement in realizing its purpose are study groups, worship services, forum discussions, conferences, lectures and addresses by prominent religious leaders, and social service in the downtown district. It is not necessary to "join" in order to share in the programme of the Movement. Its activities are open to all.

Full information may be had from the S.C.M. executives in the various Colleges, or from the General Secretaries of the S.C.M.: Rev. W. C. Lockhart, Hart House and Miss D. Fleming, Household Science Building. The names of the executives will be found in the Students' Hand Book.

CANADIAN OFFICERS TRAINING CORPS

The University of Toronto Contingent of the Canadian Officers Training Corps provides for university students, the opportunity of obtaining War Office certificates of qualification as officers in the Canadian Militia and other Empire forces. This, apart from graduation from R.M.C., is the only means by which such qualifications can be obtained without first being appointed a provisional officer in a Militia unit.

Students in the Faculty of Applied Science and Engineering may train and qualify in Artillery, Survey, Engineering, Signalling, and Infantry, thus obtaining practical instruction which is most closely allied with and complementary to their more academic University course.

Most of the officers of the Contingent are selected from undergraduate members of the Corps; and members holding certificates of qualification are eligible, if recommended, to attend summer camps of instruction in various branches of the Services. Numbers of our graduates, holding certificates of qualification, have obtained permanent commissions in the Royal Canadian Air Force, the Canadian Militia, Imperial Army, Indian Army, and Royal Air Force.

University credit in Physical Training (compulsory in the first two years of attendance) is granted to members of the Corps who complete the annual training in the Contingent.

The Contingent headquarters are at 184 College Street, and include armouries, members' reading room, library, and lecture rooms.

The Contingent Staff is:

Officer Commanding............Lieut.-Col. H. H. Madill, V.D., m.s.c.
Second in Command..............................Major W. S. Wilson
Adjutant....................................Capt. W. E. Carswell
Paymaster......................................Major T. A. Reed
Quartermaster...............................Lieut. E. G. Moogk
Medical Officer..............................Capt. D. L. MacLean

Chaplain ....

Contingent Sergeant-Major ..... S-M. W. Hunt, late Royal Welch Fusiliers

Company Commanders:

"A" Co. .... Capt. H. C. H. Miller

"B" Co. .... Capt. H. G. Oborne

"C" Co. (Applied Science) .... Major M. B. Watson, m.s.c.

"D" Co .... Capt. F. R. Crocombe

SECTION XVI. LODGING AND BOARD

GENERAL

Accommodation is readily obtainable in numerous private boarding-houses within a short distance of the University, at a cost of from ten dollars a week upwards and board obtained separately at about seven dollars per week. A list of accredited boarding-houses is kept by the Secretary of the Students' Administrative Council in Hart House and students are recommended to consult him with reference to the selection of suitable accommodation.

RESIDENCE FOR MEN

Through the generosity of the late E. C. Whitney, Esq., Mrs. Whitney and friends, the University offers to approximately one hundred and fifty men the advantages of residential life within its own grounds. The Residence consists of three Houses: South, East and North.

The regular rates are $3.25 a week for a single room or half of a suite (two bedrooms and common study). For men holding matriculation or undergraduate scholarships, for first class honour men in the Faculty of Arts, and for honours men in the other faculties, the rates are $3.00 a week. An occupant entitled to the lower rate must, when paying his rent, submit to the Bursar the evidence that he has the required standing. A student of the Faculty of Arts requiring this evidence may obtain it in the form of a certificate from the Registrar, Simcoe Hall; a student of any other Faculty may obtain it from the Secretary of his faculty.

Except under very special circumstances occupants who withdraw at any time during the session will be required to pay the full rent up to April 1st.

Applications for rooms must be submitted to the Secretary of the Residence Committee, Registrar's Office. Forms for this purpose will be supplied on request. Each application must be accompanied by a deposit, of $5.00. This deposit will be returned if the applicant is not admitted, but will be forfeited by the applicant if notification, in writing, of his refusal to accept the room assigned is not received by the Secretary before September 15th. On request the deposit will be refunded in full at the end of the college year if the room key is returned and the room and furniture left in a satisfactory condition.

The University lays down three general rules designed to prevent hazing gambling, and the use of intoxicants.

A circular giving further information may be obtained from the Secretary of the Residence Committee.

SUMMARY OF STUDENTS IN ATTENDANCE

Session 1936-37

Year	1	2	3	4	5	6	7	8	Total
I	20	76	39	4	12	67	40	24	282
II	18	37	27	2	7	70	29	15	205
III	5	32	29	6	6	43	20	13	154
IV	13	15	21	8	..	48	25	6	136
V	..	..	..	12	..	..	..	..	12
	56	160	116	32	25	228	114	58	789

For graduate students, see p. 172

APPENDIX. GRADUATE STUDIES

Graduates interested in pursuing courses for post-graduate degrees should send inquiries to the Secretary of the School of Graduate Studies.

AERONAUTICS

The University is equipped with a four-foot wind tunnel in a specially designed building; and, so far as the facilities permit, properly prepared graduates will be admitted for private study, or for a course leading to an advanced degree (M.A.Sc. or Ph.D.).

Graduates who wish to undertake this work should apply to the Committee Administering the Wind Tunnel; and, if they are candidates for an advanced degree, should also register with the Secretary of the School of Graduate Studies, in accordance with the conditions laid down in the Calendar of that School.

REGULATIONS FOR DEGREES

MASTER OF APPLIED SCIENCE, MASTER OF ARCHITECTURE

The regulations governing the Degrees of Master of Applied Science (M.A.Sc.) and Master of Architecture (M.Arch.) shall be determined as follows:

1*a*. A candidate for the degree of Master of Applied Science shall hold the degree of Bachelor of Applied Science of this University or a degree from some other University recognized as equivalent by the Council of the School of Graduate Studies.

1*b*. A candidate for the degree of Master of Architecture shall hold the degree of Bachelor of Architecture or the degree of Bachelor of Applied Science in Architecture of this University or a degree from some other University recognized as equivalent by the Council of the School of Graduate Studies.

2. He shall register with the Secretary of the School of Graduate Studies at the beginning of the academic year.

3. Not later than November 1, he shall submit to the Secretary for acceptance by the Council of the School of Graduate Studies the title of his proposed thesis as approved by the department concerned.

4. Not later than May 15, he shall present evidence to the Council of the School of Graduate Studies that he has spent not less than one academic year in the department concerned as a student enrolled in one of the following departments on a course of study approved by the department: Civil Engineering, Mining Engineering, Mechanical Engineering, Architecture, Chemical Engineering, Electrical Engineering, Metallurgical Engineering.

5. Not later than May 15, evidence that the candidate has satisfactorily met all the requirements of the department with regard to thesis and to such examinations as the department shall require, shall be forwarded to the Council of the School of Graduate Studies through the sub-committee administering the regulations governing the degrees of Master of Applied Science and Master of Architecture.

CIVIL ENGINEER, MINING ENGINEER, MECHANICAL ENGINEER, ELECTRICAL ENGINEER, CHEMICAL ENGINEER, METALLURGICAL ENGINEER

The regulations governing the Professional Degrees of Civil Engineer (C.E.), Mining Engineer (M.E.), Mechanical Engineer (M.E.), Electrical Engineer (E.E.), Chemical Engineer (Chem.E.), Metallurgical Engineer (Met.E.), shall be determined as follows:

1. A candidate for one of the said degrees shall hold the diploma of the School of Practical Science or of the Faculty of Applied Science and Engineering or the degree of Bachelor of Applied Science, or shall have spent not less than two years as a member of the teaching staff in this Faculty after having graduated in Engineering from another institution of recognized reputation.

2. He shall have spent at least three years after receiving the diploma or the degree in the actual practice of the branch of engineering wherein he is a candidate for a degree.

3. Intervals of non-employment, or of employment in other branches of engineering, shall not be included in the above three years. It shall not be necessary that the several periods requisite to make up the said three years be consecutive.

4. The candidate shall obtain from the Secretary of the School of Graduate Studies, the formal application form, which, properly filled out, accompanied by the designated evidence of professional experience and by the title and synopsis of the proposed thesis, shall be delivered to the Secretary not later than the first day of November.

The evidence of professional experience shall fully describe the kind and extent of all work undertaken by the candidate since the date of graduation up to the time of application, indicating clearly the degree of responsibility for such work. Certificates from present and past employers shall accompany the application. The names and addresses of not less than five engineers to whom the candidate is personally known and who have knowledge of his professional activities shall be submitted.

5. The application, and the subject of the thesis is subject to the approval of the Board of Examiners, who may satisfy themselves by oral or written examinations in regard to the candidate's experience and competence in engineering works.

6. The candidate after notification of the approval of the Board shall prepare an original engineering thesis in the branch in which he has applied for a degree. This thesis shall be on work in which the candidate has had

actual experience and shall preferably be on the design of engineering works or processes, and shall be accompanied by all necessary descriptions, details, drawings, bills of materials, specifications, and estimates. A thesis of a solely descriptive type will not be acceptable.

7. The thesis, with accompanying papers, described in clause 6, shall be sent to the Secretary not later than the first day of March.

8. The candidate may be required to present himself for examination in the months of March or April at such time as may be arranged by the examiners.

9. The thesis, drawings, and other papers submitted under clause 7 shall become the property of the University.

10. Nothing in this statute shall prevent any candidate from receiving more than one of the said degrees, provided he has the necessary qualifications for each degree. An interval of three years must elapse between the granting of any two degrees under this statute.

DOCTOR OF PHILOSOPHY

Graduates of the Faculty of Applied Science and Engineering may proceed to the degree of Doctor of Philosophy. Information as to the conditions to be met by candidates for this degree is to be found in the Calendar of the School of Graduate Studies, which may be obtained from the Registrar of the University. The degree is an academic degree, not a professional one, and the research work and courses leading to the degree are primarily concerned with the fundamentals and underlying principles of the sciences. In general, a candidate selects one major and two minor subjects for study, the research being carried out in the major subject. A period of three years is usually required for the fulfilment of the requirements for the degree. However, it should be understood that the degree is not granted for the passing of prescribed courses or for the performance of prescribed laboratory work for a period of three years. The laboratory research work must have led to results of a high order, constituting a real contribution to the science of the major subject, and the candidate must have attained a decided maturity of knowledge and outlook before he may present himself for final examination by the Committee of the School of Graduate Studies. A graduate proposing to proceed to this degree should consult, in the first instance, with the members of the staff in the department in which he proposes to take his major subject.

A list of major and minor options in the Department of Chemical Engineering and in the Department of Mechanical Engineering are to be found in the Calendar of the School of Graduate Studies.

HIGH SCHOOL ASSISTANTS' CERTIFICATES

The Department of Education of Ontario has agreed to accept the degree of Bachelor of Applied Science as fulfilling the academic requirement for admission to the course for a High School Assistants' certificate in the Ontario College of Education.

SPECIALISTS' CERTIFICATES

By an agreement between the University of Toronto and the Department of Education of Ontario, persons holding the degree of Bachelor of Applied Science may, by taking certain prescribed courses in the Faculty of Arts, complete the academic requirements for admission to the qualifying examination for specialist courses in (*a*) Mathematics and Physics and (*b*) Science, at the Ontario College of Education. Information regarding these prescribed courses may be obtained from a pamphlet issued by the Registrar of the University, from whom copies may be had on application. Each person who desires to complete these academic requirements should communicate directly with the Registrar in order that his case may be considered and his particular conditions defined.

The Department of Education has approved of the acceptance of the degree in Applied Science in the Department of Engineering Physics, with standing of at least 60% at the final examination, as covering the academic requirements for admission to the qualifying examination for the Specialists' course in Mathematics and Physics at the Ontario College of Education.

ONTARIO LAND SURVEYORS AND DOMINION LAND SURVEYORS

Examinations are held usually in February of each year, for the following:

Preliminary Dominion Land Surveyors
Leveller's Examination
Final Dominion Land Surveyors
Ontario Land Surveyors

Any student in this faculty is eligible for these examinations, but graduates in Civil and Mining Engineering are allowed a shortened apprenticeship before writing their final examinations. Full information respecting above examinations may be obtained from the staff in Surveying and Geodesy.

GRADUATES ENROLLED IN THE DEPARTMENTS OF THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Civil Engineering, Municipal and Structural	3
Mining Engineering	4
Mechanical Engineering	4
Chemical Engineering	7
Electrical Engineering	2
Total	20

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UNIVERSITY OF TORONTO

CALENDAR

FACULTY OF APPLIED SCIENCE
AND
ENGINEERING

1938-1939

THE UNIVERSITY OF TORONTO PRESS
1938

1938 CALENDAR 1938

JANUARY

Sun.		2	9	16	23	30
Mon.		3	10	17	24	31
Tues.		4	11	18	25	..
Wed.		5	12	19	26	..
Thur.		6	13	20	27	..
Fri.	.	7	14	21	28	..
Sat.	1	8	15	22	29	..

FEBRUARY

Sun.	.	6	13	20	27
Mon.	.	7	14	21	28
Tues.	1	8	15	22	..
Wed.	2	9	16	23	..
Thur.	3	10	17	24	..
Fri.	4	11	18	25	..
Sat.	5	12	19	26	..

MARCH

Sun.	.	6	13	20	27
Mon.	.	7	14	21	28
Tues.	1	8	15	22	29
Wed.	2	9	16	23	30
Thur.	3	10	17	24	31
Fri.	4	11	18	25	..
Sat.	5	12	19	26	..

APRIL

Sun.		3	10	17	24
Mon.		4	11	18	25
Tues.		5	12	19	26
Wed.		6	13	20	27
Thur.		7	14	21	28
Fri.	1	8	15	22	29
Sat.	2	9	16	23	30

MAY

Sun.	1	8	15	22	29
Mon.	2	9	16	23	30
Tues.	3	10	17	24	31
Wed.	4	11	18	25	..
Thur.	5	12	19	26	..
Fri.	6	13	20	27	..
Sat.	7	14	21	28	..

JUNE

Sun.	.	5	12	19	26
Mon.	.	6	13	20	27
Tues.	.	7	14	21	28
Wed.	1	8	15	22	29
Thur.	2	9	16	23	30
Fri.	3	10	17	24	..
Sat.	4	11	18	25	..

JULY

Sun		3	10	17	24	31
Mon.		4	11	18	25	..
Tues.		5	12	19	26	..
Wed.		6	13	20	27	..
Thur.		7	14	21	28	..
Fri.	1	8	15	22	29	..
Sat.	2	9	16	23	30	..

AUGUST

Sun.	.	7	14	21	28
Mon.	1	8	15	22	29
Tues.	2	9	16	23	30
Wed.	3	10	17	24	31
Thur.	4	11	18	25	..
Fri	5	12	19	26	..
Sat.	6	13	20	27	..

SEPTEMBER

Sun.	.	4	11	18	25
Mon.	.	5	12	19	26
Tues.	.	6	13	20	27
Wed.	.	7	14	21	28
Thur.	1	8	15	22	29
Fri	2	9	16	23	30
Sat.	3	10	17	24	..

OCTOBER

Sun.		2	9	16	23	30
Mon.		3	10	17	24	31
Tues.		4	11	18	25	..
Wed.		5	12	19	26	..
Thur.		6	13	20	27	..
Fri.		7	14	21	28	..
Sat.	1	8	15	22	29	..

NOVEMBER

Sun.	.	6	13	20	27
Mon.	.	7	14	21	28
Tues.	1	8	15	22	29
Wed.	2	9	16	23	30
Thur.	3	10	17	24	..
Fri	4	11	18	25	..
Sat.	5	12	19	26	..

DECEMBER

Sun.	.	4	11	18	25
Mon.	.	5	12	19	26
Tues.	.	6	13	20	27
Wed.	.	7	14	21	28
Thur.	1	8	15	22	29
Fri.	2	9	16	23	30
Sat.	3	10	17	24	31

1939 CALENDAR 1939

JANUARY

Sun.	1	8	15	22	29
Mon.	2	9	16	23	30
Tues.	3	10	17	24	31
Wed.	4	11	18	25	..
Thur.	5	12	19	26	..
Fri.	6	13	20	27	..
Sat.	7	14	21	28	..

FEBRUARY

Sun.	.	5	12	19	26
Mon.	.	6	13	20	27
Tues.	.	7	14	21	28
Wed.	1	8	15	22	..
Thur.	2	9	16	23	..
Fri.	3	10	17	24	..
Sat.	4	11	18	25	..

MARCH

Sun.	.	5	12	19	26
Mon	.	6	13	20	27
Tues.	.	7	14	21	28
Wed.	1	8	15	22	29
Thur.	2	9	16	23	30
Fri.	3	10	17	24	31
Sat.	4	11	18	25	..

APRIL

Sun.		2	9	16	23	30
Mon.		3	10	17	24	..
Tues.		4	11	18	25	..
Wed.		5	12	19	26	..
Thur.		6	13	20	27	..
Fri		7	14	21	28	..
Sat	1	8	15	22	29	..

MAY

Sun.	.	7	14	21	28
Mon	1	8	15	22	29
Tues.	2	9	16	23	30
Wed.	3	10	17	24	31
Thur.	4	11	18	25	..
Fri.	5	12	19	26	..
Sat.	6	13	20	27	..

JUNE

Sun.	.	4	11	18	25
Mon.	.	5	12	19	26
Tues.	.	6	13	20	27
Wed.	.	7	14	21	28
Thur.	1	8	15	22	29
Fri.	2	9	16	23	30
Sat.	3	10	17	24	..

JULY

Sun.		2	9	16	23	30
Mon.		3	10	17	24	31
Tues.		4	11	18	25	..
Wed.		5	12	19	26	..
Thur.		6	13	20	27	..
Fri.		7	14	21	28	..
Sat.	1	8	15	22	29	..

AUGUST

Sun.	.	6	13	20	27
Mon.	.	7	14	21	28
Tues.	1	8	15	22	29
Wed.	2	9	16	23	30
Thur.	3	10	17	24	31
Fri.	4	11	18	25	..
Sat.	5	12	19	26	..

SEPTEMBER

Sun.	.	3	10	17	24
Mon	.	4	11	18	25
Tues.	.	5	12	19	26
Wed.	.	6	13	20	27
Thur.	.	7	14	21	28
Fri.	1	8	15	22	29
Sat.	2	9	16	23	30

OCTOBER

Sun.	1	8	15	22	29
Mon	2	9	16	23	30
Tues.	3	10	17	24	31
Wed.	4	11	18	25	..
Thur.	5	12	19	26	..
Fri.	6	13	20	27	..
Sat.	7	14	21	28	..

NOVEMBER

Sun.	.	5	12	19	26
Mon.	.	6	13	20	27
Tues.	.	7	14	21	28
Wed.	1	8	15	22	29
Thur.	2	9	16	23	30
Fri.	3	10	17	24	..
Sat.	4	11	18	25	..

DECEMBER

Sun.		3	10	17	24	31
Mon.		4	11	18	25	..
Tues.		5	12	19	26	..
Wed.		6	13	20	27	..
Thur.		7	14	21	28	..
Fri.	1	8	15	22	29	..
Sat.	2	9	16	23	30	..

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SECTION I. CALENDAR 1938-1939

MICHAELMAS TERM 1938

July 1 Fri......Dominion Day. Buildings closed.
July 15 Fri......Last day for receiving applications for Supplemental Examinations.
Aug. 13 Sat.....Students of the III year, Depts. 1, 2, and 9, report at University Survey Camp.
Sept. 3 Sat.....Students of the IV year, Dept 1, Astronomy Option, report at University Survey Camp.
Sept. 5 Mon....Labour Day. Buildings closed.
Sept. 13 Tues....Supplemental Examinations commence.
Sept. 22 Thur....Special meeting of Faculty Council.
Sept. 26 Mon....Registration in person of the I year from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.
Students in Architecture of the II, III, and IV years report at University Survey Camp.
Sept. 27 Tues....Registration in person of the II and III years (except Architecture) from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.
The Dean's address to the I year at 9.00 a.m. in Room 38, Engineering Building.
Preliminary instruction for the I year in Room 38, Engineering Building.
Meeting of Faculty Council.
Sept. 28 Wed...Lectures and Laboratory work commence for I, II, and III years at 9.00 a.m.
Registration in person of the IV year (except Architecture), and the V year in Architecture, from 9.00 a.m. to 1.00 p.m. Work for these students commences at 2.00 p.m.
The opening address by the President to the students of all faculties at 4.00 p.m. in Convocation Hall.
Oct. 1 Sat....Stated meeting of the Caput to deal with requests as to social functions until November 15.
Oct. 3 Mon....Meeting of Faculty Council.
Oct. 5 Wed....Registration in person of II, III, and IV years in Architecture at the Faculty Office.
Oct. 11 Tues....Meeting of Engineering Society.
Oct. 14 Fri......Meeting of Senate.
Oct. 24 Mon....Meeting of Engineering Society.
Nov. 1 Tues....Meeting of Faculty Council.

Nov. 9 Wed....Meeting of Engineering Society.
Nov. 11 Fri......Remembrance Day. Service at the Soldiers' Tower at 11.00 a.m. Neither lectures nor laboratory classes given from 10.40 a.m. to 11.20 a.m.
Meeting of Senate.
Nov. 24 Thur....Meeting of Engineering Society.
Dec. 1 Thur....Meeting of Faculty Council.
Dec. 9 Fri......Meeting of Senate.
Meeting of Engineering Society.
Dec. 17 Sat.....Michaelmas term ends at 12.00 noon.
Dec. 26 Mon....Buildings closed.

EASTER TERM 1939

Jan. 2 Mon....Buildings closed.
Jan. 3 Tues....Easter Term begins.
Mid-session Examinations commence.
Meeting of Faculty Council.
Jan. 9 Mon....Meeting of Engineering Society.
Jan. 13 Fri......Meeting of Senate.
Jan. 24 Tues....Meeting of Engineering Society.
Feb. 1 Wed....Meeting of Faculty Council.
Feb. 8 Wed....Meeting of Engineering Society.
Feb. 10 Fri......Meeting of Senate.
Feb. 23 Thur....Meeting of Engineering Society.
Mar. 1 Wed....Meeting of Faculty Council.
Meeting of Engineering Society. (Nominations.)
Mar. 3 Fri......Engineering Society Annual Elections.
Mar. 10 Fri......Meeting of Senate.
Mar. 13 Mon....Engineering Society Annual General Meeting.
Apr. 3 Mon....Meeting of Faculty Council.
Apr. 5 Wed....Easter Term ends at 5.00 p.m.
Apr. 7-10 Fri.-Mon...Easter. Buildings closed.
Apr. 12 Wed....Annual Examinations commence.
Apr. 14 Fri......Meeting of Senate.
May 1 Mon....Meeting of Faculty Council.
May 12 Fri......Meeting of Senate.
May 24 Wed....Victoria Day. Buildings closed.
June 7 Wed....Meeting of Senate.
June 8-9 Thur.-Fri...University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

1937-1938

THE UNIVERSITY

President. .THE HON. AND REV. H. J. CODY, M.A., D.D., LL.D., F.R.S.C.
Registrar. . . . . .A. B. FENNELL, M.C., M.A.
Bursar. . . . . F. A. MOURÉ, MUS. DOC.
Librarian. . . . . .W. S. WALLACE, M.A., F.R.S.C.
Superintendent of Buildings and Grounds. . . . . A. D. LEPAN, B.A.SC.
Director of University Extension and Publicity. . W. J. DUNLOP, B.A., B.PAED.
Warden of Hart House. . . . . .J. B. BICKERSTETH, M.C., M.A.
Director of University Health Service. . . . . .G. D. PORTER, M.B.
Medical Adviser for Women Students. .MISS E. GORDON, B.A., M.B., D.P.H.
Manager of the University of Toronto Press. . . . .

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean. . . . . . .C. H. MITCHELL, C.B., C.M.G., D.S.O., C.E., LL.D., D.Eng.
Secretary. . . . . .W. S. WILSON, B.A.SC., M.E.I.C.

INQUIRIES

Inquiries about admission to the Faculty of Applied Science and Engineering should be sent to the Registrar of the University.

Communications relating to curriculum, instruction and examinations, in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information about opportunities for graduates of this Faculty, reference may be made to a pamphlet issued by the Director of University Extension and Publicity entitled "Opportunities for Graduates of Applied Science and Engineering."

SECTION III. TEACHING STAFF

1937-1938

PROFESSORS

E. A. Allcut, M.Sc. (Birm.), M.E. (Tor.), M.I.Mech.E. 48 Foxbar Rd.
Professor of Mechanical Engineering.

G. R. Anderson, M.A., A.M. (Har.), M.I.E.S., F.A.S.A. 7 Rose Park Cr.
Professor Emeritus of Engineering Physics and Photography.

R. W. Angus, B.A.Sc., M.E., Hon. M.E.I.C., M.A.S.M.E.
Professor of Mechanical Engineering. Mechanical Bldg.

E. G. R. Ardagh, B.A.Sc., F.C.I.C., F.R.S.C. 80 Strathallan Blvd.
Professor of Applied Chemistry.

E. R. Arthur, M.A., B.Arch. (Liverpool), A.R.I.B.A. 163 Walmer Rd.
Professor of Architectural Design.

J. W. Bain, B.A.Sc., F.I.C., F.R.S.C. 393 Brunswick Ave.
Professor of Chemical Engineering.

E. W. Banting, B.A.Sc. 101 Farnham Ave.
Associate Professor of Civil Engineering: Surveying and Geodesy.

B. de F. Bayly, B.A.Sc. 2 Douglas Cresc.
Assistant Professor of Electrical Engineering.

M. C. Boswell, B.A.Sc., M.A. (Har.), Ph.D., F.R.S.C. Mining Bldg.
Professor of Organic Chemistry (in Chemical Engineering).

H. J. Burden, D.S.O., D.F.C., B.A.Sc., M.F.A. (Princ.)
Assistant Professor of Architecture. 26 Old Forest Hill Rd.

J. R. Cockburn, M.C., V.D., B.A.Sc., M.E.I.C. 100 Walmer Rd.
Professor of Descriptive Geometry.

S. R. Crerar, B.A.Sc., D.L.S. 122 Grenadier Rd.
Associate Professor of Surveying.

W. B. Dunbar, B.A.Sc., A.M.E.I.C. 241 Glebeholme Blvd.
Assistant Professor of Engineering Drawing.

F. C. Dyer, B.A.Sc., M.E.I.C. 164 Colin Ave.
Associate Professor of Mining Engineering.

G. A. Guess, M.A. (Qu.) Oakville, Ont.
Professor of Metallurgical Engineering.

H. E. T. Haultain, C.E., M.E.I.C. 156 Glencairn Ave.
Professor of Mining Engineering.

K. B. Jackson, B.A.Sc. 362 Glengrove Ave. W.
Assistant Professor of Applied Physics.

J. T. King, B.A.Sc. 126 Manor Rd. E.
Associate Professor of Mining Engineering.

A. T. Laing, B.A.Sc. 146 Balmoral Ave.
Associate Professor of Highway Engineering (retired).

T. R. LOUDON, B.A.Sc., M.E.I.C. 189 Sheldrake Blvd.
Professor of Applied Mechanics.

W. G. MCINTOSH, B.A.Sc. 105 Bedford Rd.
Assistant Professor of Mechanical Enginering.

R. R. MCLAUGHLIN, M.A.Sc., M.A., Ph.D. 52 Rosedale Rd.
Assistant Professor of Chemical Engineering.

H. H. MADILL, V.D., B.A.Sc., F.R.A.I.C. 14 Strathallan Blvd.
Professor of Architecture.

J. W. MELSON, B.A.Sc. 69 Walmsley Blvd.
Associate Professor of Civil Engineering: Surveying and Geodesy.

R. J. MONTGOMERY, B.Sc., Cer.E. (Ohio) 7 Cottingham Rd.
Associate Professor of Ceramics.

C. F. MORRISON, B.E. (Sask.), M.Sc. (McG.), A.M.E.I.C., 29 Claxton Blvd.
Assistant Professor of Civil Engineering: Municipal and Structural.

J. A. NEWCOMBE, B.Sc. (London), A.R.S.M. 10 Bowmore Rd.
Associate Professor of Metallurgical Engineering.

H. W. PRICE, B.A.Sc. 40 Ava Rd.
Professor of Electrical Engineering.

T. R. ROSEBRUGH, M.A., D.Sc., F.R.S.C. 92 Walmer Rd.
Professor Emeritus of Electrical Engineering.

W. L. SAGAR, B.A.Sc., C.E., A.M.E.I.C. 38 Melrose Ave.
Assistant Professor of Civil Engineering: Municipal and Structural

E. A. SMITH, M.A. (McM.) Mining Bldg.
Assistant Professor of Chemical Engineering.

V. G. SMITH, B.A.Sc. 49 Nealon Ave.
Assistant Professor of Electrical Engineering.

W. J. SMITHER, B.A.Sc., M.E.I.C. 35 Wilberton Rd
Associate Professor of Structural Engineering.

R. TAYLOR, B.A.Sc. 82 Glen Echo Rd.
Associate Professor of Mechanical Engineering.

J. E. TOOMER, B.Sc. (N. Carolina) 26 Edgar Ave.
Assistant Professor of Metallurgy.

W. M. TREADGOLD, B.A. 13 Woodlawn Ave. E.
Professor of Civil Engineering: Surveying and Geodesy.

A. WARDELL, B.A.Sc. 124 Melrose Ave
Assistant Professor of Engineering Drawing.

C. H. C. WRIGHT, B.A.Sc., M.R.A.I.C. 419 Markham St.
Professor Emeritus of Architecture.

W. J. T. WRIGHT, M.B.E., B.A.Sc. 126 Melrose Ave.
Associate Professor of Engineering Drawing.

C. R. YOUNG, B.A.Sc., C.E., M.E.I.C. 119 Glenayr Rd.
Professor of Civil Engineering: Municipal and Structural.

A. R. ZIMMER, B.A. Sc. 80 Pine Crest Rd.
Associate Professor of Electrical Engineering.

LECTURERS

A. E. BERRY, M.A.Sc., C.E., Ph.D. — 235 Gainsborough Rd.
Special Lecturer in Municipal Engineering.

R. J. BROWN, B.A.Sc. — 272 Beresford Ave.
Lecturer in Electrical Engineering.

W. E. CARSWELL, B.Arch. — Apt. 231, 215 College St.
Lecturer in Architecture.

H. S. M. CARVER — Lorne Park House, Lorne Park
Special Lecturer in Town Planning.

T. L. CROSSLEY., A.M.E.I.C. — 28 Lonsdale Rd.
Special Lecturer in Pulp and Paper.

H. B. DUNINGTON-GRUBB — 4 St. Thomas St.
Special Lecturer in Landscape Architecture.

J. N. GOODIER, M.A., Ph.D. (Camb.), Sc.D. (Mich.) — 21 Cornish Rd.
Special Lecturer in Applied Mechanics.

R. R. GRANT, O.L.S., C.A. — 58 Poplar Plains Rd.
Special Lecturer in Accountancy and Business.

G. H. HALLY, B.A.Sc. — Aurora
Lecturer in Mechanical Engineering.

P. V. JERMYN, B.A.Sc., M.E.I.C. — 109 Cluny Dr.
Lecturer in Engineering Drawing.

F. H. KIRKPATRICK, Ph.B. (Hiram) — 157 Alexandra Blvd.
Special Lecturer in Public Speaking.

R. E. LAIDLAW, B.A.Sc, K.C. — 11 Dewbourne Ave.
Special Lecturer in Engineering Law.

M. J. C. LAZIER, B.A.Sc. — 184 Briar Hill Ave.
Lecturer in Applied Mechanics.

G. R. LORD, B.A.Sc., S.M. (M.I.T.) — 40 Maxwell Ave.
Lecturer in Mechanical Engineering.

A. S. MATHERS, B.A.Sc., F.R.A.I.C., A.R.C.A. — 110 Highbourne Rd.
Special Lecturer in Architecture.

J. J. SPENCE, A.M.E.I.C. — 162 Glencairn Ave.
Lecturer in Engineering Drawing.

R. C. WIREN, B.A.Sc., M.E.I.C., M.A.S.M.E. — East House, U. of T.
Lecturer in Mechanical Engineering.

S. E. WOLFE, M.A.Sc. — 80 Rusholme Rd.
Lecturer in Assaying.

INSTRUCTORS

G. P. BEAL, M.A.Sc. — 68 Lakeview Ave.
Instructor in Chemical Engineering.

J. G. BRECKENRIDGE, B.A.Sc., Ph.D. (Camb.) — 21 Cluny Ave.
Instructor in Chemical Engineering.

R. M. CLARK, B.A.Sc. — 44 Willcocks St.
Instructor in Engineering Drawing.

F. COATES, A.R.C.A. — Scarborough Bluffs
Instructor in Modelling.

G. R. EDWARDS, B.A.Sc. — 1263 King St. W.
Instructor in Engineering Drawing.

A. M. FITZGERALD, B.A.Sc. — 150 Summit Dr.
Instructor in Chemical Engineering.

V. L. HENDERSON, B.A.Sc., A.M. (Mich.) — 18 Boswell Ave.
Instructor in Applied Physics.

W. J. JACKSON, M.A.Sc. — East House, U. of T.
Instructor in Applied Physics.

C. W. JEFFERYS, R.C.A., O.S.A., LL.D.(Qu.) — 4111 Yonge St., York Mills, Ont.
Instructor in Painting.

MISS J. C. LAING, B.A. — 8 Williamson Rd.
Librarian, and Instructor in Architectural History and French.

L. S. LAUCHLAND, B.A.Sc. — North House, U. of T.
Instructor in Electrical Engineering.

J. E. REID, B.A.Sc. — 124 Bloor St. W.
Instructor in Electrical Engineering.

T. L. ROWE — 104 Braemore Gardens
Instructor in Civil Engineering: Surveying and Geodesy.

MACKENZIE WATERS, M.C., V.D., B.A.Sc., F.R.A.I.C., A.R.C.A. — 267 Roxborough St. E.
Special Instructor in Architectural Design.

S. E. WOLFE, M.A.Sc. — Streetsville
Instructor in Mining Engineering.

DEMONSTRATORS

ADELMAN, M., B.A.Sc. — 77 Madison Ave.
Demonstrator in Chemical Engineering.

ANTHES, R. G., B.A.Sc. — 182 Fulton Ave.
Demonstrator in Electrical Engineering.

BEYNON, C. E., B.A.Sc. — East House, U. of T.
Demonstrator in Thermodynamics.

BIRSS, R. J., B.A.Sc. — Brampton
Demonstrator in Thermodynamics.

BRIDGLAND, C. J., M.A.Sc. — 266 South Kingsway
Demonstrator in Electrical Engineering.

CARSWELL, J. M., M.M., B.A.Sc. — 111 Spruce Hill Rd.
Demonstrator in Engineering Drawing.

COOK, H. H., B.A.Sc. — 95 St. George St.
Demonstrator in Engineering Drawing.

EWENS, W. E., B.A.Sc. — 104 Dawlish Ave.
Demonstrator in Engineering Drawing.

FASKEN, N. R., B.A.Sc. Apt. 406, 1531 Bathurst St.
Demonstrator in Chemical Engineering.
FOREMAN, A. S., B.A.Sc. 34 Highview Cresc.
Demonstrator in Thermodynamics.
FRANKISH, T. A., B.A.Sc. 617 Spadina Ave.
Demonstrator in Mining Engineering.
FRY, J. W. B.A.Sc. Apt. 3, 797 Bloor St. W.
Demonstrator in Hydraulics.
GALLOWAY, S. H., B.A.Sc. Apt. 12, 82 Eglinton Ave. E.
Demonstrator in Electrical Engineering.
HAMER, I. M., B.A.Sc. Ryerson House, Emmanuel Coll.
Demonstrator in Applied Mechanics.
HAMLY, D. H., M.A., PH.D. 106 Keewatin Ave.
Demonstrator in Applied Physics.
HELWIG, C. E., M.A.Sc. 61 Braemore Gdns.
Demonstrator in Civil Engineering: Municipal and Structural.
HEWER, W. A. M., B.A.Sc. 1240 Shaw St.
Demonstrator in Mining Engineering.
HIGGINS, W. A., B.A.Sc. 34 Douglas Ave.
Demonstrator in Machine Design.
HOOD, G. L., B.Sc. (E.E.) (Man.) 252 College St.
Demonstrator in Electrical Engineering.
HOPPER, S. A. J., B.A.Sc. 527 Shaw St.
Demonstrator in Civil Engineering: Surveying and Geodesy.
HOULE, A. U., B.A.Sc. 90A Barton Ave.
Demonstrator in Electrical Engineering.
JONES, L. E., B.Sc. (C.E.) (Man.), M.A.Sc. 199 Spadina Rd.
Demonstrator in Applied Physics.
JUNKER, R. H., B.A.Sc. 335 Huron St.
Demonstrator in Mining Engineering.
MACDONALD, W. C., M.A.Sc. 184 Glen Rd.
Demonstrator in Chemical Engineering.
MACDOUGALL, L. G., B.A.Sc. East House, U. of T.
Demonstrator in Electrical Engineering.
MCNEVAN, D. C., B.Sc. (E.E.) (Man.) 27 Willcocks St.
Demonstrator in Engineering Drawing.
MARKS, B., B.A.Sc., 2306 Bloor St. W.
Demonstrator in Chemical Engineering
MOHUN, W. A., B.A.Sc. 38 The Palisades
Demonstrator in Applied Physics.
MORRISON, W. B., B.A.Sc. 931 College St.
Demonstrator in Electrical Engineering.
PARKER, W. E. B., M.A.Sc. 216 Deloraine Ave.
Demonstrator in Hydraulics.
RAPSON, W. H., M.A.Sc. Apt. 25, 70 Gloucester St.
Demonstrator in Chemical Engineering.

RICKER, E. A., B.A.Sc. *Demonstrator in Electrical Engineering.*	686 Spadina Ave.
SMITH, W. D., B.A.Sc. *Demonstrator in Hydraulics.*	56 St. Mary St.
TRELOAR, J. B., B.A.Sc. *Demonstrator in Machine Design.*	104 Lansdowne Ave.
TURRALL, W. T., M.A.Sc. *Demonstrator in Mining Engineering.*	2 Maplewood Ave.
WEATHERBURN, A. S., B.A.Sc. *Demonstrator in Chemical Engineering.*	38 Macpherson Ave.
WOODLEY, C. J., B.A. *Demonstrator in Engineering Drawing.*	318 Huron St.

PROFESSORS OF OTHER FACULTIES GIVING INSTRUCTION TO STUDENTS IN APPLIED SCIENCE

F. C. AULD, B.A. (McG.), M.A., B.C.L. (Ox.) — 21 Poplar Plains Cres.
Professor of Roman Law and Jurisprudence and Special Lecturer in Commercial Law.

S. BEATTY, M.A., Ph.D., F.R.S.C. — 537 Markham St.
Professor of Mathematics.

H. BOESCHENSTEIN, Ph.D. (Rostock) — 103 Bedford Rd.
Assistant Professor of German.

R. BRAUER, Ph.D.(Berlin) — 91 Bernard Ave.
Assistant Professor of Mathematics.

J. D. BURK, B.A. — 30 Duggan Ave.
Assistant Professor of Mathematics.

J. T. BURT-GERRANS, Phm. B., M.A., Ph.D. — 46 Dewson St.
Professor of Electrochemistry.

E. F. BURTON, B.A. (Tor.), (Camb.), Ph.D., F.R.S.C.
Professor of Physics. — 224 Queens Drive, Weston

J. B. FERGUSON, B.A., F.R.S.C. — 100 Albertus Ave.
Associate Professor of Chemistry.

L. GILCHRIST, M.A., Ph.D. (Chic.), F.R.S.C. — North House, U. of T.
Professor of Physics.

T. HEDMAN, Ph.B. (Chic.) — 171 Old Forest Hill Rd.
Associate Professor of German.

F. B. KENRICK, M.A., Ph.D. (Leip.), F.R.S.C. — 77 Lonsdale Rd.
Professor of Chemistry.

G. B. LANGFORD, B.A.Sc., Ph.D.(Corn.) — 14 Wychwood Park
Professor of Mining Geology.

A. MACLEAN, B.A. — 488 Spadina Ave.
Professor of Geology.

E. S. MOORE, M.A., Ph.D. (Chic.), F.R.S.C. — 18 Indian Grove
Professor of Geology.

A. L. PARSONS, A.B. (N.Y.) — 15 Glencairn Ave.
Professor of Mineralogy.

I. R. POUNDER, M.A., Ph.D. (Chic.) — 19 Glen Gordon Rd.
Professor of Mathematics.

D. A. F. ROBINSON, M.A., Ph.D. (Chic.) — 592 University Ave.
Assistant Professor of Mathematics.

L. J. ROGERS, B.A.Sc., M.A. — 110 Garfield Ave.
Professor of Chemistry.

J. SATTERLY, M.A. (Camb.), D.Sc. (Lond.), F.R.S.C. — 95 Bernard Ave.
Professor of Physics.

J. L. SYNGE, M.A., Sc.D. (Dub.), F.R.S.C., — 222 Rose Park Dr.
Professor of Applied Mathematics.

J. E. THOMSON, B.A.Sc., Ph.D. (Har.), F.R.S.C. — 123 Welland Ave.
Professor of Mineralogy.

A. M. WYNNE, M.A. (Qu.), Ph.D. — 27 Lytton Blvd.
Associate Professor of Biochemistry.

SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate by statute, subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909-1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910-1911. In the session 1923-1924 the Degree of B.Arch. was offered to students in Architecture.

SECTION V. ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

GENERAL

1. Candidates for admission to the Faculty of Applied Science and Engineering must submit evidence to show that they are qualified to take one of the courses of instruction and proceed to a degree. Applicants must also submit a certificate of good character, and must have completed the seventeenth year of their age. The procedure for application and registration is described in paragraph 8 below.

2. In general, the holding of any of the following classes of certificate will constitute qualification for admission to this Faculty.

(*a*) Certificates of Ontario Pass and Honour Matriculation as described in paragraph 3 below.

(*b*) Certificates of having passed certain equivalent examinations as described in paragraph 5 below.

(*c*) Certificates of undergraduate work in other universities. See admission ad eundem statum, paragraphs 6 and 7 below.

The Senate will consider applications for the recognition of certificates other than those mentioned as occasion may require. Such certificates must be accompanied by an official statement of the marks in the various subjects upon which the certificate was granted.

ONTARIO MATRICULATION

3. Certificates of Ontario Matriculation for admission to the Faculty of Applied Science and Engineering must cover complete Pass Matriculation, and five subjects of Honour Matriculation.

PASS MATRICULATION

Complete Pass Matriculation will consist of these subjects:

English (Literature and Composition)
History (Canadian and Ancient), or Canadian History and Music,
Mathematics (Algebra and Geometry),
And three of: Greek (Authors and Accidence),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition), or
Spanish (Authors and Composition),
Science (Physics or Agriculture Part I, and Chemistry or Agriculture Part II),
Arithmetic with Mechanical Drawing* and Shop Work.*

*Credit in Mechanical Drawing and Shop Work will consist of certificates from the Principal of the School, accompanied by an approving certificate from the Director of the Technical School Branch of the Department of Education for Ontario. This option applies to students—and to such students only—who have been in attendance at, and matriculate from, a Technical School in the Province of Ontario and are so certified by the Department of Education of the Province

HONOUR MATRICULATION

Honour Matriculation will consist of these subjects:

English (Literature and Composition),
Algebra and Geometry,†
Trigonometry,†
Science (Physics and Chemistry),
And one of Greek (Authors and Composition),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition),
Spanish (Authors and Composition).

†Admission to the Department of Engineering Physics will be granted only to those who have met the regular requirements for admission to the Faculty of Applied Science and Engineering and, in addition, have obtained an average of 75 per cent. in the Mathematics (Algebra, Geometry, and Trigonometry) of the Honour Matriculation Examination. Students whose general proficiency record in other subjects is not correspondingly high are advised not to seek admission to the course.

4. Those intending to enter the course in Architecture are recommended to select French as one of the Matriculation subjects; those intending to enter Chemical, Civil, Electrical, or Mechanical Engineering or Engineering Physics are recommended to select German; while those intending to enter Metallurgical Engineering are advised to select Spanish.

EQUIVALENT EXAMINATIONS

5. Certificates of the following examinations recognized as equivalent in value to the Ontario Matriculation, Pass, or Honour may be accepted in so far as they meet the Ontario requirements in subjects and percentages and conform to the admission requirements of the universities of the respective provinces. A candidate applying for admission on such certificates must submit an official statement of the marks upon which these certificates were awarded.

Province of Ontario

Middle School or Upper School examinations or examinations of the same standard under other names.

Province of Quebec

Quebec High School Leaving and Senior High School Leaving Examination Certificates; the Junior and Senior Matriculation examinations of McGill University.

Province of New Brunswick

Grammar School or First Class Licenses; also the Superior, except for Latin.

Province of Nova Scotia

High School Certificates of Grade XI and Grade XII issued by the Department of Education.

Province of Manitoba

Grade XI and Grade XII examinations.

Province of British Columbia

Junior (Grade XII) and Senior (Grade XIII) Matriculation examinations.

Province of Prince Edward Island

First Class License Certificates issued either by the Education Department or Prince of Wales College; Third Year Certificates issued by the above College.

Province of Alberta

Grade XI and Grade XII examinations.

Province of Saskatchewan

Grade XI and Grade XII examinations.

Newfoundland and the Maritime Provinces

Certificate of the Common Examining Board, Junior and Senior Associate Diplomas of the Department of Education of Newfoundland.

Great Britain

Certificate of having passed, or having exemption from, the Preliminary Examination of the Institution of Civil Engineers in the British Isles, or equivalent.

ADMISSION AD EUNDEM STATUM

6. An undergraduate of another university may be admitted ad eundem statum on such conditions as the Senate, on the recommendation of the Council of the Faculty, may prescribe.

7. An applicant for admission ad eundem statum must submit with his application for admission: (1) an official transcript of his record in the University from which he wishes to transfer, showing in detail the courses which he has completed with his standing in each; (2) certificate of honourable dismissal; (3) certificate of vaccination; and (4) calendar of the university giving a full description of these courses.

PROCEDURE FOR APPLICATION AND REGISTRATION

8. Candidates for admission should apply to the Registrar of the University for forms of applications for admission; they are required to fill in these forms in duplicate and return them to the Registrar *not later than* September 10th, together with the following: (*a*) all Pass and Honour Matriculation or equivalent certificates which they may hold; (*b*) any other evidence of ability to take the work proposed; (*c*) certificate of good character; (*d*) certificate of vaccination. Failure to make early application will result in delay and inconvenience for the candidate.

9. By order of the Board of Governors, all candidates for admission must submit a certificate of successful vaccination with their application, or agree to submit such certificate within ten days after the opening of the session. The Directors of the University Health Services will arrange for the vaccination of those who so desire.

10. Every student must register in person with the Secretary of the Faculty as prescribed on page 5 of the Calendar.

11. A student who fails to register as prescribed in clause 10, must petition the Council for permission to register late. The Council, however, reserves the right to refuse the permission, or to impose a penalty, such penalty to be reckoned at one dollar per day, or part thereof, that elapses betweeen the close of registration as prescribed and the filing of the petition.

12. A petition for permission to register late must be accompanied by a deposit equal to the estimated amount of the penalty. Should the Council decide that no penalty is to be imposed, the deposit will be refunded.

SECTION VI. FEES AND DEPOSITS

1. Every student in attendance proceeding to a Bachelor's Degree in the Faculty of Applied Science and Engineering is required to pay the following annual fees: Composite, Medical Examination and Physical Training, Hart House (women exempt), Students' Administrative Councils, Engineering Society, and Athletic Association (women exempt). These fees are described in detail below.

All fees due in the Michaelmas term, with the exception of the Hart House fee, must be paid in full on or before October 15th, and all fees due in the Easter term on or before January 15th; after these dates a deferred payment fee of one dollar a month will be imposed in each term until the whole amount is paid.

2. Special fees are required for matriculation, supplemental examinations, admission ad eundem statum, and degrees.

3. (a) *Students must have paid fees due in the first term before proceeding to the work of the second term. A student will not be admitted to any of the University lectures or laboratory classes who is in arrears for his fees.*

(b) *A student will not be allowed to write any examination if he has not paid all fees for which he is liable at that time.*

COMPOSITE

4. (*a*) The composite fee, payable to the Bursar of the University, including tuition, library, laboratory supplies (but not laboratory deposits), and one annual examination for each year, shall be as follows:

If paid in full on or before October 15th.................... $225.00

If paid in instalments:—

First instalment, if paid on or before October 15th...... 113.00

Second instalment, if paid on or before January 15th.... 115.00

(*b*) A student who is repeating his year is required to pay the same fee as other students.

SUPPLEMENTAL EXAMINATION

5. Candidates for supplemental examinations are required to pay a fee to the Bursar not later than September 1st. The fee is $10.00 for either one or two supplemental examinations. For each supplemental examination in a laboratory subject requiring special supervision the fee is $20.00.

MATRICULATION, OR REGISTRATION OF MATRICULATION

6. Applicants for admission under paragraph 2, (*b*), (*c*), section V, are required to pay to the Bursar a fee of $5.00 for registration of matriculation.

ADMISSION AD EUNDEM STATUM

7. Applicants who are admitted ad eundem statum are required to pay to the Bursar a fee of $10.00.

DEGREES

8. Candidates for the degree of B.A.Sc., or B. Arch., are required to pay to the Bursar by January 15th of their year of graduation, a fee of $10.00.

MEDICAL EXAMINATION AND PHYSICAL TRAINING

9. Every man is required at the opening of each session in which Physical Training is compulsory for such student, to pay to the Bursar the annual fee of $5.00 for medical examination and such subsequent physical training as may be prescribed.

10. Every woman is required to pay a corresponding fee of $4.00.

HART HOUSE

11. Every man in attendance is required to pay to the Bursar on or before November 15th the annual fee of $12.00 for the maintenance of Hart House. If this fee is not paid by the above date a deferred payment fee of $2.00 will be imposed, making the total fee $14.00.

ATHLETIC FEE

12. Every student in attendance proceeding to a Bachelor's degree is required to pay to the Bursar on or before October 15th the annual Athletic fee of $3.00.

STUDENTS' ADMINISTRATIVE COUNCILS

13. Every student is required to pay to the Bursar at the time of registration the annual fee, as shown in the summary below, paragraph 17, for the maintenace of the Students' Administrative Councils.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

14. All students in attendance are required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Engineering Society.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

15. Each man in attendance is required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Athletic Association of the Faculty.

LABORATORY DEPOSIT

16. A laboratory breakage deposit, to be paid to the Faculty at the time of registration, is required from all students. The amount of the deposit is shown in the summary below. This deposit, less charges for waste, neglect, and breakages, will be refunded by the Secretary at the end of the session. Should the deposit be insufficient to meet the charges, a levy will be made to cover the deficiency.

17. SUMMARY OF FEES AND DEPOSITS

Composite in advance	$225.00 B
In instalments	228.00 B
Supplemental Examinations*	
Written or laboratory (one or two)	10.00 B
Laboratory requiring special supervision	20.00 B
Matriculation, or registration of Matriculation	5.00 B
Degrees (B.A.Sc., B.Arch)	10.00 B
Medical Examination and Physical Training* (men)	5.00 B
Medical Examination and Physical Training* (women)	4.00 B
Hart House (women exempt)	12.00 B
Athletic Fee	3.00 B
Students' Administrative Councils,	
All Years except Graduating Year	2.00 B
Graduating Year	6.00 B
Engineering Society	2.00 F
Athletic Association (women exempt)	2.00 F
Laboratory Deposit, Civil, Mechanical, and Electrical Engineering, Architecture, and Engineering Physics	3.00 F
Mining, Chemical, and Metallurgical Engineering, and Mining Geology	8.00 F

Items marked "B" *are payable at the office of the Bursar; items marked* "F" *are payable at the Faculty Office at the time of registration.*

All cheques must be made payable to "University of Toronto."

*18. Every student who has neglected to complete satisfactorily the course in Physical Training of the First or Second Year, and who must take this work during a later year, will be required to pay to the Bursar at the opening of that session a supplemental fee of $10.00 in addition to the prescribed Medical Examination fee.

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating department, or school in which he intends to proceed to a degree. There are eight departments in Engineering and the School of Architecture from which the selection may be made; viz.,

Civil Engineering (Dept. 1),
Mining Engineering (Dept. 2),
Mechanical Engineering (Dept. 3),
Architecture (Dept. 4),
Engineering Physics (Dept. 5),
Chemical Engineering and Applied Chemistry (Dept. 6),
Electrical Engineering (Dept. 7),
Metallurgical Engineering (Dept. 8-8a).
Mining Geology (Dept. 9).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the courses in Engineering; and Bachelor of Architecture, to those who complete the course in Architecture.

3. The courses in Engineering extend over four academic years; the course in Architecture extends over five. A student must pass in the work of each academic year before proceeding to the work of the next. See p. 135, para. 3.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 19th, 1938.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction in Engineering and Architecture are given in Sec. IX, p. 25.

7. Examinations are conducted as explained in Sec. X, p. 135.

8. Students in Mining and Mechanical Engineering, Architecture, Electrical Engineering, and Mining Geology are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. (See Sec. IX, p. 30, 34, 37, 60, 111 and 123).

9. Graduates in Engineering and Architecture may proceed to post graduate and professional degrees. The post graduate degrees include M. Arch., M.A.Sc., Ph.D.; and the professional degrees, C.E., Chem. E., E.E., M.E. (Mechanical Engineer), M.E. (Mining Engineer), and Met. E.

The courses for these degrees are under the direction of the School of Graduate Studies, and candidates should send their inquiries to the Secretary of the School of Graduate Studies. Some of the requirements of these courses are given in an appendix to this Calendar.

SECTION VIII. SCHOOL OF ENGINEERING RESEARCH

THE SCHOOL

A School of Engineering Research, within the Faculty of Applied Science and Engineering, was established in the Spring of 1917 at the suggestion of the late Dean Ellis.

The School is under the direct supervision of a Committee of Management composed of members of the Faculty Council. To this Committee of the Council is entrusted the selection of researches to be undertaken under the auspices of the School, and the disposition of funds for conducting them.

The School was organized chiefly for the training of graduates in methods of research, and for the carrying out of investigations. These latter may be problems relating to specific industries or raw materials and having a specific end in view, or general problems having to do with fundamental principles.

RESEARCH ASSISTANTS

A number of research assistants in the School of Engineering Research are appointed annually on salary in the various departments of the Faculty to carry on the work of research under direction of members of the staff. This work is accepted as partial fulfilment of the requirements for the degrees of M.A.Sc.,M.Arch. and Ph.D. These research assistants are usually recent graduates, and are chosen from among those who have displayed special capacity for investigation in their undergraduate courses. Applicants should consult with members of the staff as soon as possible after the April examinations.

The facilities of the School are also open to graduates who desire to penetrate more deeply into particular phases of experimental work, or to undertake investigations either suggested by members of the staff or arising from their own work since graduation.

INQUIRIES

All communications should be sent to the Secretary, Professor M. C. Boswell, Ph.D.

SECTION IX. CURRICULUM

The courses of instruction are designed to give the student a thorough grounding in the fundamentals of engineering or architecture; and, in addition, sufficient familiarity with the practical application of the principles to make him useful upon graduation. The courses are very similar in the First Year with the exception of those of Architecture, Engineering Physics and Chemical Engineering. In the succeeding years specialization develops to some extent with provision in the Third and Fourth years for optional courses in some of the graduating departments.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As the future engineer is vitally concerned with the development of the country, it is essential that he be instructed in the rudiments of economics, administration, and business, which, with his scientific training, will enable him to increase his usefulness to the full.

In some graduating departments, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful training in methods of research. In this way the undergraduate course is linked with the graduate courses, and with the work of the School of Engineering Research (page 24).

As part of the laboratory instruction, excursions to places of technical interest, both in Toronto and elsewhere, are arranged by the staff. These excursions are treated as laboratory periods with the same requirements as to attendance and reports. The total transportation costs in any one year will probably not exceed ten dollars.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The program and regulations regarding the courses of study and examinations, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course, to the conditions here laid down.

Communications relating to curricula, instruction and examinations, in the Faculty of Applied Science and Engineering, should be sent to the Secretary of the Faculty.

DEPARTMENT OF CIVIL ENGINEERING
(DEPT. 1)

The course in Civil Engineering has been so designed as to be broad and comprehensive, with a view to meeting not only the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire a technical training of such a basic character as to enable them to enter various other fields of technical employment. Concurrent with the instruction in engineering subjects, sufficient attention is given to economic, legal and administrative matters to make the graduate in this Department fitted to enter not only upon such work as Municipal Engineering, Sanitary Engineering, Highway Engineering, Railway Engineering, Geodetic Surveying, Structural Engineering and Hydraulic Engineering, but also upon administrative and executive work in both engineering and industrial undertakings.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 115.

FIRST YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus...............	236	2	–	2	–
Applied Physics............	187	1	3	1	3
Business....................	121	–	–	1	–
Descriptive Geometry.......	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Problems and Drawing................	166a	–	10	–	17
General Chemistry..........	84	2	–	1	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus....................	237	2	–	2	–
Chemical Laboratory.........	89	–	–	–	6
Descriptive Geometry........	162	1	–	1	–
Economics and Finance......	123	1	–	1	–
Electricity..................	143, 144a	1	–	1	3
Elementary Astronomy......	71	1	–	1	–
Engineering Problems and Drawing................	167a	–	5	–	10
Engineering Chemistry.......	93	1	–	–	–
Geology....................	195	–	–	2	–
Inorganic Chemistry.........	87a	1	–	–	–
Least Squares...............	240	–	–	1	–
Mechanics of Materials......	4	2	–	2	–
Mineralogy.................	257, 259	2	1	–	2
Organic Chemistry..........	95	–	–	1	–
Physical Metallurgy.........	252	–	–	1	–
Physical Training...........	280	–	2	–	2
Public Speaking.............	133	–	–	1	–
Spherical Trigonometry......	239	1	–	–	–
Surveying..................	272, 273	1	9	1	–

THIRD YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Elasticity...........	10a	1	–	1	–
Astronomy and Geodesy.....	72, 73	2	2	2	–
Cements and Concrete.......	11	1	–	1	–
Descriptive Geometry........	164	1	–	–	–
Engineering Chemistry.......	102	1	–	1	–
Engineering Problems and Drawing................	168a	–	13	–	14
Engineering Geology.........	197	1	–	1	–
Hydraulics..................	205, 206	2	–	2	3

THIRD YEAR SUBJECTS DEPT. 1—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Machinery	229	1	–	1	3
Mechanics of Materials Lab.	9	–	5	–	–
Stress Graphics	10	1	–	1	–
Survey Camp	275	–	–	–	–
Surveying	274	1	–	1	–
Theory of Structures	6	2	–	2	–
Thermodynamics	223, 224	1	–	1	2

FOURTH YEAR SUBJECTS DEPT. 1 (a) GENERAL OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Contracts and Specifications	127	–	–	1	–
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	1	–
Foundations	14	1	–	1	–
Hydraulics	211	1	3	1	–
Management	128	1	–	–	–
Mechanics of Materials Lab.	13	–	3	–	3
Miscellaneous Structures	19	–	–	1	–
Reinforced Concrete	15	1	–	1	–
Structural Design	17, 18	2	–	1	–
Theory of Structures	12	2	–	2	–
Thesis	285	–	3	–	–

And *one* of the following Elective Groups:

(1) Engineering Problems and Drawing	178a	–	15	–	15
(1) Highway Engineering	268	–	–	1	3
(1) Municipal Administration	131	–	–	1	–
(1) Sanitary Engineering	267, 267a	1	–	1	3
(1) Soil Mechanics	14a	1	–	–	–
(2) Engineering Problems and Drawing	178a	–	15	–	15
(2) Railway Engineering	269	1	–	2	4
(2) Railway Structures	269a	1	–	–	2
(2) Soil Mechanics	14a	1	–	–	–
(3) Engineering Problems and Drawing	178a	–	12	–	18
(3) Photographic Surveying	189	3	3	2	3

FOURTH YEAR SUBJECTS DEPT. 1 (b) ASTRONOMY OPTION	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Astronomy	74, 76	2	23	2	–
Contracts and Specifications	127	–	–	1	–
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Geodesy	75, 76	2	–	2	23
Management	128	1	–	–	–
Photographic Surveying	189a	1	2	1	2
Survey Camp	275	–	–	–	–
Thesis	285	–	3	–	–

DEPARTMENT OF MINING ENGINEERING
(DEPT. 2)

The course in Mining Engineering, which originated in 1878 as a course in Assaying and Mining Geology, is intended to serve as a preliminary training for those who expect to practise in some branch of Mining Engineering, such as exploration of mining areas and primary development, mine surveying, mining processes involving civil, mechanical and electric work of underground workings, mining machinery and operation; milling and treatment of ores, assaying and other forms of analysis and research, and administrative work in both engineering and industrial undertakings.

A candidate for the degree in the Department of Mining Engineering will be required to present satisfactory evidence of having had at least six months' practical experience in work connected with mining, metallurgy or geology, for which he must have received regular wages.

The time may be spent in geological survey, in ore dressing, smelter, or lixiviation works, in an assay office in the vicinity of mining or metallurgical works, in prospecting, or on any work in or about a mine other than as an office man, or clerk. Prospecting will only count one-half (*e.g.*, four months' prospecting will be counted as two months) and must not be submitted for more than three of the six months. Not more than three months on geological surveys or in assaying will be accepted as part of the six months.

It is important to note that this experience may be put in before the student is admitted to the University.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 115.

FIRST YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry. and....	238	1	–	2	–
Calculus................	236	2	–	2	–
Business....................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Elementary Petrography.....	260a	–	–	2	–
Engineering Problems and Drawing................	166b	–	9	–	12
General Chemistry..........	84	2	–	1	–
Mineralogy................	256, 258	2	1	–	1
Mining Laboratory..........	50	–	–	–	3
Physical Training...........	280	–	2	–	2
Problems and Seminar.......		–	3	–	3
Statics....................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	89, 90	–	6	–	6
Descriptive Geometry........	162	1	–	1	–
Economics and Finance......	123	1	–	1	–
Electricity..................	143	1	–	1	–
Engineering Problems and Drawing................	167b	–	3	–	10
General Geology............	198	2	–	1	2
Inorganic Chemistry.........	87a	1	–	–	–
Inorganic Chemistry.........	87b	–	–	1	–
Mechanics of Materials......	4	2	–	2	–

SECOND YEAR SUBJECTS DEPT. 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Metallurgy	241	–	–	1	–
Mineralogy	261	–	2	–	2
Mining	51, 53	1	3	–	–
Physical Training	280	–	2	–	2
Problems and Seminar		–	3	–	3
Steam Engines	216	1	–	–	–
Surveying	272a, 273	1	6	1	–
Theory of Measurements	65	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88, 99	1	6	1	3
Assaying	45, 46	1	3	–	3
Economic Geology	202, 203	1	–	3	2
Engineering Chemistry	102	1	–	1	–
Engineering Problems and Drawing	168b	–	6	–	3
Geological Field Work	193	–	–	–	–
Hydraulics	205, 206	2	–	2	3
Introductory Research	66	–	3	–	–
Metallurgy	243	1	–	1	–
Mining	54	1	–	1	–
Ore Dressing	58, 59	1	–	1	6
Petrography	262, 263	1	2	1	2
Physics of Ore Dressing	64	1	–	1	–
Problems and Seminar		–	3	–	3
Survey Camp	275	–	–	–	–
Theory of Structures	7	1	–	1	–
Vacation Work	69	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	47, 48	–	–	1	3
Electrical Laboratory	144a	–	3	–	–
Engineering Economics	125	–	–	1	–
Geology, Mining	200	–	–	2	–
Geology, Pleistocene and Physiographic	194, 201	1	1	1	–
Geology, Precambrian	199	2	–	–	–
Machine Design	234	1	–	1	3
Mechanics of Materials Lab.	9	–	–	–	3
Metallurgy	247	1	–	1	6
Mine Cost-Finding and Management	56	1	–	1	–
Mine Ventilation	57	2	3	–	–
Mining	55	1	–	1	–
Ore Dressing	60, 61	1	6	1	–
Problems and Seminar		–	3	–	3
Thermodynamics	223, 224	1	3	1	–
Thesis	67	–	7	–	9
Vacation Work	70	–	–	–	–

DEPARTMENT OF MECHANICAL ENGINEERING
(Dept. 3)

The mechanical engineer is concerned with the production and the use of power, and it is part of his work to design and manufacture suitable machinery for this purpose, and to instal and operate it. The Diesel engine and the steam turbine are the products of his effort, and he applies these prime movers to automobiles, aeroplanes, locomotives and other purposes. His work also includes the design of water turbines, and their use in hydro-electric systems.

Other branches of his work are the making of designs for air compressors, machine tools, pumps, refrigerating machines and their application to storage warehouses and ice-making, heating and ventilating equipment, materials-handling and conveying plants, and generally all mechanical work. General industrial and administrative problems are considered.

An effort is being made to help qualified students interested in the design of aeroplanes and high speed trains and cars, without laying undue stress on such work. Courses of lectures are provided and in the final year some laboratory work in the wind tunnel is available.

The following course of study has been devised to equip men for this service.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 115.

SHOP WORK

Every student registered in the Department of Mechanical Engineering is required to spend 1200 hours in mechanical work satisfactory to the Department. Half of this work is required to be done before the student commences his Third Year Annual Examinations in April, and the balance before he commences his Fourth Year Annual Examinations in April. The details in this regard are outlined in the Calendar under subjects 227a and 227b.

All or any part of this shop work may be completed before the student enters the University, and he is urged to complete all of it at as early a date in his course as possible.

Failure to meet the specified requirements within the time set will result in a failure in shop work, which will be dealt with similarly to a failure in any laboratory subject.

Certificate forms for this work may be obtained from the Secretary of the Faculty or from the Department.

FIRST YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus	236	2	–	2	–
Applied Physics	185a	1	3	1	3
Business	121	–	–	1	–
Descriptive Geometry	160	1	–	1	–
Dynamics	2	2	–	2	–
Electricity	135	2	–	2	–
Engineering Problems and Drawing	166c	–	9	–	15
General Chemistry	84	2	–	1	–
Machines and Processes	228	1	–	1	–
Physical Training	280	–	2	–	2
Properties of Fluids	213	1	–	1	–
Statics	1	2	–	2	–
Surveying	270, 271	1	4	–	–
Technical English	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or	291	2	–	2	–
Calculus	237	2	–	2	–
Chemical Laboratory	89	–	–	–	6
Descriptive Geometry	162	1	–	1	–
Dynamics	3	1	–	1	–
Economics and Finance	123	1	–	1	–
Electricity	136, 137	2	3	2	3
Engineering Chemistry	93	1	–	–	–
Engineering Problems and Drawing	167c	–	15	–	8
Hydrostatics	212	–	–	1	–
Inorganic Chemistry	87a	1	–	–	–
Machines and Processes	228a	1	–	1	–
Mechanics of Materials	4, 9	2	–	2	3
Metallurgy	241	–	–	1	–
Organic Chemistry	95	–	–	1	–
Physical Training	280	–	2	–	2
Properties of Fluids	214	1	–	1	–
Steam Engines	216	1	–	1	–
Theory of Mechanism	230	2	–	2	–

THIRD YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Electrical Laboratory	140	–	4½	–	3
Engineering Chemistry	102	1	–	1	–
Engineering Problems and Drawing	168c	–	6	–	3
Heat Engines	218	2	–	2	–
Hydraulics	205, 206	2	–	2	3
Machine Design	233	2	9	2	8
Magnetism and Electricity	138	1	–	1	–
Mechanics of Machinery	231	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Shop Work	227a	–	–	–	–
Theory of Structures	7	1	–	1	–
Thermodynamics	217, 219	2	3	2	3

FOURTH YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Engineering Problems and Drawing	178c	–	3	–	–
Heat Treatment of Iron and Steel	253	1	–	1	–
Hydraulics	207, 208, 209	3	9	3	6
Industrial Management	130	1	–	1	–
Reinforced Concrete	20	1	–	–	–
Machine Design	235	2	6	2	9
Shop Work	227b	–	–	–	–
Structural Design	17, 18	2	–	–	–
Thermodynamics	220, 221, 222	3	6	3	9
Thesis	285	–	1	–	1

SHOP WORK

Attention is directed to the note on shop work on page 34.

SCHOOL OF ARCHITECTURE

(DEPT. 4)

The School of Architecture was established as a Department of the Faculty of Applied Science and Engineering in 1890 and is one of the oldest schools in the British Empire. The School is fortunate in enjoying a close connection with the Ontario Association of Architects and the Royal Architectural Institute of Canada, both of which organizations offer prizes and scholarships for competition in the School. Constant touch is kept between students and architects by lectures given fortnightly by prominent practitioners.

The School is one of a limited number in the Empire recognized by the Royal Institute of British Architects, which admits graduates to Associate Membership on application, without examination. The student is required to spend twelve months (1900 hours) in the offices of recognized architects. This very important practical work is done in the long summer vacations and satisfactory evidence of its completion must be submitted before the granting of a degree. The Ontario Association of Architects, through its Registration Board, accepts the degree in Architecture coupled with the office practice requirement as qualification to practise the profession of Architecture in the Province of Ontario. As a matter of fact, however, few graduates commence practice without a continuation of their practical training. Travel in Europe is managed by most students, even with slender means, and their ability to sketch and photograph buildings does much to enrich their own cultural experience, and, indirectly, the architecture of the Province in which they will ultimately live. In the Fourth and Fifth Years, students may select either the Design Option or the Structural Option. In selecting the latter option, the student decides that his interests tend toward the engineering side of Architecture. Art subjects closely related to architecture, such as modelling, water colour drawing, etc., take their proper place in the course and are described in the following pages. An event in the academic year is the period spent at Gull Lake, a University Camp, where a week is spent under supervision and instruction sketching out of doors.

Broadly speaking, the course is arranged to lay a foundation for the subsequent life of the graduate. A very considerable portion of the course is devoted to architectural design, and a student graduating should have a thorough knowledge of the principles of this important subject. He should have formed a taste and developed an appreciation of the allied arts, which should make him a valuable member of any community.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 115.

FIRST YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus...............	236	2	–	2	–
Architectural Design.........	31	–	12	–	14
Building Construction.......	37	–	–	1	–
Descriptive Geometry........	161	1	–	1	–
Elements of Arch. Form......	28	1	–	1	–
Engineering Problems and Drawing................	166d	–	4	–	4
Freehand Drawing..........	35	–	2	–	2
French....................	44	2	–	2	–
History of Architecture......	25	1	–	1	–
Physical Training...........	280	–	2	–	2
Statics....................	1	2	–	2	–
Surveying	270a, 271a	1	3	–	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Design.........	31a	–	15	–	15
Descriptive Geometry........	163	1	–	1	–
Economics and Finance......	123	1	–	1	–
English....................	122b	1	–	1	–
Freehand Drawing and Water Colour................	35a	–	2	–	2
French....................	44a	1	–	1	–
History of Architecture......	25a	1	–	1	–
Mechanics of Materials.......	5	2	–	2	–
Modelling..................	36	–	2	–	2
Photography...............	188	1	3	1	3
Physical Training...........	280	–	2	–	2
Theory of Arch. Planning....	32	1	–	1	–
Vacation Work..............	41	–	–	–	–

THIRD YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Composition....	33	1	–	1	–
Architectural Design.........	31b	1	20	–	20
Commercial Law............	124	1	–	1	–
Freehand Drawing and Water Colour................	35b	–	2	–	2
Functional Requirements of Buildings...............	26	1	–	1	–
Garden Design..............	27	1	–	–	–
History of Architecture......	25b	1	–	–	–
History of Architecture	25c	–	–	1	–
Light and Acoustics.........	190	1	2	1	2
Modelling..................	36a	–	2	–	2
Public Speaking.............	133	1	–	–	–
Structural Design...........	8	1	3	1	3
Vacation Work..............	42	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Building Materials..........	38	1	–	1	–
Building Stones.............	204	1	–	–	–
Ceramic Building Materials...	254j	–	–	1	–
Contracts and Specifications ..	127	–	–	1	–
Freehand Drawing from Life..	35c	–	2	–	2
Functional Requirements of Buildings...............	26	1	–	1	–
Garden Design..............	27a	1	–	–	–
History of Fine Art..........	30	1	–	1	–
Illumination Design.........	191	1	1	1	1
Modelling..................	36b	–	2	–	2
Sanitary Science............	39	1	–	1	–
Structural Design...........	16	1	3	1	3
Vacation Work..............	43	–	–	–	–
and either					
Architectural Design, *or*......	31c	1	21	1	21
Architectural Engineering....	31e	1	21	1	21

FIFTH YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Arch. Aspects of Town Planning	34	–	–	1	–
Architectural Economics	40a	1	–	1	–
Heating and Air Conditioning.	40	1	–	1	–
Professional Practice.........	39a	1	–	1	–
Structural Design...........	21	1	3	1	3
Water Colour and Life Drawing.....................	35d	2	–	2	–
and either					
Architectural Design, *or*......	31d	2	26	2	26
Architectural Engineering....	31f	2	28	2	28

DEPARTMENT OF ENGINEERING PHYSICS
(Dept. 5)

Admission to this course is granted only to students who meet the special requirements set forth on page 17 of this Calendar.

The course is designed to afford a training in Mathematics and Physics beyond that which it is possible to give in the other undergraduate courses in engineering. It is believed that a wider and more thorough acquaintance with the basic sciences will bring to the student a readier appreciation of the nature of the technical problems with which he will later be confronted and a greater facility in the solution of them. A course of the kind offered should consequently be of particular value to those who desire to enter governmental or industrial research laboratories, or who wish to engage in any original work of investigation or development in the field of applied physics.

Throughout the four years of the course an effort is made to maintain the practical point of view in the theoretical instruction. This is effected, in part, by adopting wherever possible the engineering viewpoint in the teaching of mathematical and scientific subjects, and, in part, by the inclusion of certain basic engineering instruction.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Algebra and Calculus, 292, page 126.

First Year Subjects Dept. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Algebra and Calculus	292	$3\frac{1}{2}$	–	$3\frac{1}{2}$	–
Analytical Geometry	293	$1\frac{1}{2}$	–	$1\frac{1}{2}$	–
Descriptive Geometry	160	1	–	1	–
Electricity	135	2	–	2	–
Engineering Problems and Drawing	166e	–	3	–	6
Engineering Mechanics	5a	2	–	2	–
General Chemistry	85, 86	2	3	1	3
German	265a	2	–	2	–
Mineralogy	255, 258a	2	1	–	–
Physical Training	280	–	2	–	2
Properties of Matter, Mechanics and Heat	301	3	$4\frac{1}{2}$	3	$4\frac{1}{2}$

SECOND YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Geometry of Space	296	1	–	1	–
Descriptive Geometry	162	1	–	1	–
Differential Calculus	294	2	–	2	–
Electricity	136, 137	2	3	2	–
Elementary Acoustics	304	1	–	–	–
Elementary Light	303	1	–	1	–
Elementary Machine Design	234a	1	3	1	3
Elementary Magnetism and Electricity	302	2	–	1	–
Engineering Chemistry	93	1	–	–	–
German	265b	1	–	1	–
Integral Calculus and Differential Equations	295	3	–	3	–
Magnetism, Electricity, Light, and Acoustics	305	–	3	–	6
Mechanics of Materials	4a, 9	2	–	2	3
Physical Chemistry	98	2	–	2	–
Physical Training	280	–	2	–	2

Students in the Department of Engineering Physics are required to state at the beginning of the Third Year the options that they desire to pursue in the Third and Fourth Years. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give the work.

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Engineering Mechanics	5b	1	–	1	–
Alternating Current	139	1	–	1	–
Differential Equations	297	1	–	1	–
Introduction to the Theory of Functions	298	1	–	1	–
Magnetism and Electricity	138	2	–	1	–
Physical Laboratory	311	–	3	–	3
Physical Metallurgy	244	–	–	2	–
Properties of Matter	309	2	–	2	–
Theoretical Mechanics	331	1	–	1	–

And *one* of the following options which must be continued in the Fourth Year.

Option 5c, Electricity and Communications					
Option 5s, X-Rays and Spectroscopy					
Option 5i, Illumination and Acoustics					
Electrical Design	141	1	–	1	–
Electrical Laboratory	140	–	6	–	6
Heat	310	1	–	1	–
Optics	312	1	3	1	3
Theory of Potential and Electrical Measurements	307	1	–	1	–
Option 5g, Geophysics					
Electrical Laboratory	140	–	6	–	6
Elementary Geology	195	–	–	2	–
Heat	310	1	–	1	–
Mineralogy	260	1	–	1	–
Optics	312	1	3	1	3
Theory of Potential and Electrical Measurements	307	1	–	1	–

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5h, Applied Hydromechanics					
Aircraft	341	1	–	1	3
Electrical Laboratory	140	–	3	–	3
Engineering Problems and Drawing	168eh	–	3	–	3
Heat	310	1	–	1	–
Hydrodynamics	313	1	–	1	–
Theory of Structures	7	1	–	1	–
Thermodynamics	225	2	–	2	3
Option 5e, Elasticity of Materials and Structures					
Electrical Laboratory	140	–	3	–	3
Engineering Problems and Drawing	168ee	–	6	–	9
Optics	312	1	3	1	3
Stress Graphics	10	1	–	1	–
Theory of Structures	7	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5c, Electricity and Communications					
Acoustics	149	1	–	–	–
Advanced Acoustics	316	1	–	–	–
Applied Electricity	145a, 145b	3	–	3	–
Communication	147, 148, 150, 151	2	6	2	6
Conduction through Gases, Radioactivity, and Atomic Structure	315	1	–	1	–
Differential Equations of Mathematical Physics	332	2	–	2	–
Electrical Laboratory	146	–	6	–	6
Electromagnetic Theory	153	2	–	2	–
Engineering Economics	125	–	–	1	–
Mathematical Operations applied to Physics	306	1	–	1	–
Operational Calculus	152	2	–	2	–
Physical Laboratory	317	–	3	–	3
Thesis	285	–	–	–	–
Option 5s, X-Rays and Spectroscopy					
Acoustics	149	1	–	–	–
Advanced Acoustics	316	1	–	–	–
Advanced Optics	318	1	–	1	–
Communication	147, 148, 150, 151	2	6	2	6
Conduction through Gases, Radioactivity, and Atomic Structure	315	1	–	1	–
Differential Equations of Mathematical Physics	332	2	–	2	–
Electromagnetic Theory	153	2	–	2	–
Elementary Quantum Theory	320	–	–	1	–
Engineering Economics	125	–	–	1	–
Mathematical Operations Used in Physics	306	1	–	1	–
Mineralogy	264	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5s, X-Rays and Spectroscopy (continued)					
Operational Calculus	152	2	–	2	–
Organic Chemistry	110a	1	–	1	–
Physical Laboratory	317	–	9	–	9
Series Spectra	319	–	–	1	–
Thesis	285	–	–	–	–
X-Rays and Crystal Structure	321	1	–	1	–
Option 5g, Geophysics					
Differential Equations of Mathematical Physics	332	2	–	2	–
Economic Geology	202, 203a	1	3	3	3
Electromagnetic Theory	153	2	–	2	–
Geophysics	322	2	9	2	9
Location of Mineral Deposits	203b	–	–	2	–
Mining Geology	200	–	–	2	–
Organic Chemistry	110a	1	–	1	–
Petrography	262, 263	1	2	1	2
Precambrian Geology	199	2	–	–	–
Wave Motion in Elastic Media	323	1	–	1	–
Option 5h, Applied Hydromechanics					
Aerodynamics	342	2	–	2	–
Aircraft Engines	343	1	–	1	–
Airplane Design and Stress Analysis	344	2	9	2	9
Differential Equations of Mathematical Physics	332	2	–	2	–
Dynamic Meteorology	326	1	–	1	–
Hydrodynamic Laboratory	345	–	6	–	6
Mathematical Operations applied to Physics	306	1	–	1	–
Theoretical Hydrodynamics	334	2	–	2	–
Thesis	285	–	4	–	4

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5e, Elasticity of Materials and Structures					
Advanced Structural Analysis .	12a	2	6	2	6
Applied Elasticity............	10b	–	–	1	–
Differential Equations of Mathematical Physics....	332	2	–	2	–
Engineering Mechanics Laboratory....................	13a	–	6	–	6
Mathematical Operations applied to Physics........	306	1	–	1	–
Operational Calculus.........	152	2	–	2	–
Theory of Elasticity..........	333	1	1	1	1
Theory of Structures.........	12	2	–	2	–
Thesis.....................	285	–	–	–	–
Wave Motion in Elastic Media.	323	1	–	1	–
and *one* of the following:					
(*a*) Vibration of Structures	23, 23a	1	3	1	3
(*b*) Vibration of Machines	23, 23a	1	3	1	3
Option 5i, Illumination and Acoustics					
Advanced Acoustics..........	316	1	–	–	–
Architectural Acoustics.......	191a	1	3	3	9
Differential Equations of Mathematical Physics....	332	2	–	2	–
Mathematical Operations applied to Physics........	306	1	–	1	–
Operational Calculus.........	152	2	–	2	–
Photometry and Illumination Design..................	192b	2	6	2	6
Physical Laboratory..........	325	–	3	–	3
Physics of Light Production...	324	1	–	1	–
Thermionic Tubes............	147, 148	2	6	–	–

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(DEPT. 6)

The course is designed to give the student a thorough training in the underlying principles and laboratory methods of inorganic, organic, physical and analytical chemistry, in the applications of these to industrial chemistry and chemical engineering, and a general knowledge of the elements of thermodynamics, hydraulics, machine design, structural design, electricity, and metallurgy. A preliminary training of this nature with subsequent practical experience will enable him to undertake the design and construction and also the operation and management of the plant required in such branches of chemical industry as are concerned with the production of chemical and pharmaceutical products, petroleum and its products, rubber goods, leather and glue, soap, meat products, foodstuffs, vegetable and animal oils, sugar, pulp and paper, vegetable and animal fibres, artificial silk, coal tar and wood distillates, paints and varnishes, explosives, dyes, portland cement, metals and their alloys, electrochemical products, fermentation products, fertilizers, etc.

For those who by temperament and ability are attracted to chemical research there exist excellent opportunities in government, industrial, and medical research laboratories. Properly qualified students wishing to pursue experimental investigation as a life-work whether in industrial chemistry or in purely scientific chemistry may proceed in this department to the degrees M.A.Sc. and Ph.D., the laboratory research work of the Fourth Year serving as a connecting link between the undergraduate and graduate courses.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 115.

FIRST YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Biological Laboratory........	80	–	–	–	3
Business....................	121	–	–	1	–
Chemical Laboratory........	86	–	12	–	12
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Problems and Drawing................	166f	–	3	–	3
General Chemistry..........	85	2	–	1	–
German....................	265	2	–	2	–
Mineralogy..................	255	2	–	–	–
Mineralogy Laboratory......	258b	–	1	–	1
Optics	185b	1	3	1	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	–	2	–
Calculus...................	237	2	–	2	–
Applied Physics Laboratory ..	186	–	–	–	1
Chemical Laboratory........	92, 97	–	10	–	8
Economics and Finance......	123	1	–	1	–
Electricity..................	136, 137	2	3	2	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Problems and Drawing................	167f	–	7	–	3
German....................	265	1	–	1	–
Hydrostatics................	212	–	–	1	–
Industrial Chemistry.........	94	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Industrial Chemistry	94a	–	–	–	5
Inorganic Chemistry	87a	1	–	–	–
Inorganic Chemistry	87b	–	–	1	–
Mechanics of Materials	4	2	–	2	–
Metallurgy	241	–	–	1	–
Organic Chemistry	96	2	–	2	–
Physical Chemistry	98	2	–	2	–
Physical Training	280	–	2	–	2

THIRD YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Analytical Chemistry	88	1	–	1	–
Assaying Laboratory	49	–	3	–	–
Chemical Laboratory	100, 104a, 106	–	13	–	13
Chemical Engineering	104	1	–	1	–
Electrical Laboratory	144b	–	–	–	3
Electrochemistry	107, 108	2	3	–	–
Engineering Chemistry	102	1	–	1	–
Engineering Problems and Drawing	168f	–	3	–	3
German	265	1	–	1	–
Hydraulics	205, 206	2	–	2	$1\frac{1}{2}$
Industrial Chemistry	103	1	–	1	–
Metallurgy	243	1	–	1	–
Organic Chemistry	105	2	–	2	–
Physical Metallurgy	244	–	–	2	–
Theory of Structures	7	1	–	1	–
Thermodynamics	217, 224	2	–	2	$1\frac{1}{2}$

FOURTH YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	111	–	17	–	–
Engineering Law	126	1	–	–	–
German, *or*.................	265	1	–	1	–
Spanish................	266	1	–	1	–
Industrial Management......	130	1	–	1	–
Inorganic Chemistry.........	109	2	–	2	–
Machine Design.............	234	1	–	1	3
Organic Chemistry..........	110	1	–	1	–
Thesis.....................	285	–	–	–	–
and *one* of					
1. Electrochemistry.........	114, 115	2	*	2	*
2. Industrial Chemistry	112, 113	1	*	1	*
3. Metallurgy and	247	1	*	1	*
Ore Dressing and	62, 63, 64	2	–	2	6
Physical Metallurgy.	250	1	*	1	*
4. Ceramics................	254a	4	*	2	*
	254b	–	6	–	9
	254f	2	*	1	*
5. Zymology..............	283	*	*	*	*

*All time not otherwise allotted must be spent in the various laboratories in the proportions assigned by the Department.

For information regarding the courses of study leading to the degrees, Master of Applied Science and Doctor of Philosophy, see pp. 174 and 176 of this calendar, also the calendar of the School of Graduate Studies, which gives full particulars.

DEPARTMENT OF ELECTRICAL ENGINEERING
(Dept. 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields beside that of his specialty, electrical technique. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but also thermodynamics, hydraulics, theory of mechanisms, machine design, business, economics and finance, commercial law, and other non-electrical subjects.

In the electrical field much time is given to calculation of circuits of electric, magnetic and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years. Certain options in this Year are available in combination with general electrical engineering; viz., hydraulics, thermodynamics, communication, electrochemistry and illumination.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial or administrative responsibilities.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 115.

First Year Subjects Dept. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	3	4	3
Analytical Geometry and.....	238	1	3	2	3
Calculus...............	236	2		2	
Applied Physics.............	185a	1	3	1	3
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Engineering Problems and Drawing................	166g	–	9	–	12
General Chemistry..........	84	2	–	1	–
Physical Training...........	280	–	2	–	2
Practical Experience and Reading................	276	–	–	–	–
Statics....................	1	2	–	2	–
Surveying..................	270, 271	1	4	–	–
Technical English...........	122a	1	–	1	–

Second Year Subjects Dept. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	291	2	3	2	3
Calculus..................	237	2	3	2	3
Chemical Laboratory........	89	–	6	–	–
Descriptive Geometry........	162	1	–	1	–
Dynamics..................	335	1	1	1	1
Economics and Finance......	123	1	–	1	–
Electricity (Measurements)...	136	2	–	2	–
Electricity (Fundamentals and Networks).............	136a	1	–	1	–
Electrical Laboratory........	137	–	3	–	3
Elementary Machine Design..	232	1	–	1	–
Engineering Chemistry.......	93	1	–	–	–
Engineering Problems and Drawing................	167g	–	6	–	9
Hydrostatics................	212	–	–	1	–
Inorganic Chemistry.........	87a	1	–	–	–
Mechanics of Materials.......	4	2	–	2	–
Physical Training...........	280	–	2	–	2
Practical Experience & Reading	276	–	–	–	–
Steam Engines..............	216	1	–	1	–
Theory of Mechanism.......	230	2	–	2	–

THIRD YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Commercial Law	124	1	–	1	–
Electrical Design	141	1	–	1	–
Electrical Problems and Design Laboratory	142	–	6	–	6
Electrical Laboratory	140	–	6	–	6
Engineering Chemistry	102	1	–	1	–
Hydraulics	205, 206	2	–	2	3
Machine Design	233	2	3	2	3
Magnetism and Electricity	138	2	–	1	–
Mathematical Applications in Electrical Engineering	154	1	–	1	–
Mechanics of Machinery	231	1	–	1	–
Physical Metallurgy	244	–	–	2	–
Practical Experience and Reading	276	–	–	–	–
Thermodynamics	217, 219	2	3	2	–

FOURTH YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Electricity	145, 146	5	19	5	19
Engineering Economics	125	–	–	1	–
Engineering Law	126	1	–	–	–
Industrial Management	130	1	–	1	–
Practical Experience	276	–	–	–	–
Thesis	285	–	–	–	–
and *one* of					
1. Communication	147, 148, 149 150, 151	3	9	2	9
2. Electrochemistry	114, 115	2	9	2	9
3. Hydraulics	207, 208, 209	3	9	3	6
4. Illumination	192, 192a	2	9	2	9
5. Thermodynamics	220, 221, 222	3	9	3	6

DEPARTMENT OF METALLURGICAL ENGINEERING
(DEPT. 8-8a)

Two separate courses of instruction are offered in this department. These are designated 8 and 8a. No. 8 deals with the treatment of ores and the metals from metallic minerals. No. 8a deals with the Ceramic and industrial non-metallic mineral field.

Course 8 is planned for those who intend to pursue Engineering work in connection with the milling or concentration of ores, the production of metals from ores or concentrates, the refining of metals or the manufacture and fabrication of steel and other alloys.

Course 8a offers a training for those who intend to work as Engineers in the ceramic and non-metallic mineral industries. Ceramics deals with the preparation of raw materials for and the manufacture of such products as refractories, cement, heavy clay products, porcelain, glass and enameled iron. Non-metallic mineral engineering includes the beneficiation and commercial utilization of such materials as asbestos, clay, diatomite, feldspar, gypsum, limestone, quartz and talc.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each; e.g., Analytical Geometry (238), page 115.

FIRST YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and	238	1	–	2	–
Calculus................	236	2	–	2	–
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics.................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Engineering Problems and Drawing...............	166h	–	13	–	19
General Chemistry..........	85	2	–	1	–
Mineralogy.................	255, 258a	2	1	–	–
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	4	–	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	87a, 87b, 91	1	14	1	13
Economics and Finance	123	1	–	1	–
Electricity	136, 137	2	3	2	3
Engineering Problems and Drawing	167h	–	3	–	6
Fuels and Combustion	242	1	–	1	–
Geology and Ore Deposits	196	1	1	1	1
Mechanics of Materials	4	2	–	2	–
Metallurgy	241	–	–	1	–
Mining	51, 52	1	–	1	–
Physical Training	280	–	2	–	2
Steam Engines	216	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current	139	1	–	1	–
Analytical Chemistry	88	1	–	1	–
Assaying	45, 46	1	3	–	3
Cements and Concrete	11	1	–	–	–
Chemical Laboratory	101	–	–	–	6
Electrical Laboratory	144c	–	3	–	3
Electrochemistry	107, 108	2	3	–	–
Engineering Problems and Drawing	168h	–	3	–	–
Engineering Chemistry	102	1	–	1	–
Heat Engines	218	1	–	1	–
Metallurgy	245	2	3	1	6
Ore Dressing	58, 59	1	3	1	3
Physical Metallurgy	246	1	3	1	–
Physics of Ore Dressing	64	1	–	1	–
Thermodynamics	223, 224	1	–	1	3

Fourth Year Subjects Dept. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	47, 48	–	–	1	3
Contracts and Specifications	127	–	–	1	–
Electrochemistry	114, 115	2	–	2	6
Engineering Economics	125	–	–	1	–
Hydraulic Laboratory	210	–	–	–	3
Machine Design	234	1	–	1	3
Metallurgy	249	1	–	1	–
Metallurgy Problems	248	2	4	2	4
Ore Dressing	60, 61	1	6	1	–
Physical Metallurgy	250	1	3	1	3
Physical Metallurgy	251	–	3	–	–
Plant Management	129	–	–	1	–
Thesis	285	–	6	–	6

Students who registered in the Faculty previous to the Session 1937-38 and who elect to take the Ceramics option as formerly prescribed may carry out the work of the Third Year as prescribed in the 1936-37 Calendar during the Session 1938-39, and the work of the Fourth Year during the Sessions 1938-39 and 1939-40.

FIRST YEAR SUBJECTS DEPT. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus...............	236	2	–	2	–
Business..................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity..................	135	2	–	2	–
Elementary Mineralogy......	255, 258a	2	1	–	–
Engineering Problems and Drawing...............	166ha	–	3	–	3
General Chemistry..........	85	2	–	1	–
Inorganic Chemistry.........	86	–	9	–	15
Physical Training...........	280	–	2	–	2
Statics.....................	1	2	–	2	–
Surveying..................	270, 271	1	4	–	–
Technical English...........	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	92	–	10	–	8
Economics and Finance......	123	1	–	1	–
Elementary Machine Design..	232	1	–	1	–
Elementary Metallurgy......	241	–	–	1	–
Electricity..................	136, 137	2	3	2	3
Engineering Chemistry.......	93	1	–	–	–
Engineering Problems and Drawing..............	167ha	–	7	–	3
Geology and Ore Deposits....	196	1	1	1	1
Hydrostatics................	212	–	–	1	–
Industrial Chemistry........	94	1	–	1	–
Industrial Chemistry........	94a	–	–	–	5
Inorganic Chemistry.........	87a	1	–	–	–
Inorganic Chemistry.........	87b	–	–	1	–
Mechanics of Materials......	4	2	–	2	–
Organic Chemistry...........	110a	1	–	1	–
Physical Chemistry..........	98	2	–	2	–
Physical Training...........	280	–	2	–	2

Third Year Subjects Dept. 8*a*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88	1	–	1	–
Ceramics	254c	–	–	2	–
Chemical Engineering	104	1	–	1	–
Electrical Laboratory	144b	–	–	–	3
Electricity	139	1	–	1	–
Elementary Petrography	260	1	–	1	–
Engineering Chemistry	102	1	–	1	–
Engineering Problems and Drawing	168ha	–	3	–	3
Industrial Chemistry	100	–	13	–	3
Metallurgy	243	1	–	1	–
Non-metallic Minerals	254a	4	–	2	–
Non-metallic Mineral Laboratory	254b	–	6	–	9
Physical Metallurgy	244	–	–	2	–
Thermodynamics	217, 224	2	–	2	1½
Theory of Structures	7	1	–	1	–

Fourth Year Subjects Dept. 8*a*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Ceramic Calculations	254d	1	–	–	–
Economic Geology	203c	–	–	2	–
General Petrography	262	1	–	1	–
General Petrography	263	–	2	–	2
Glass and Enamels	254g	1	–	1	–
Hydraulics	205, 206	2	–	2	1½
Industrial Management	130	1	–	1	–
Machine Design	234	1	–	1	3
Non-Metallic Mineral Laboratory	254e	–	6	–	3
Non-Metallic Mineral Laboratory	254i	–	6	–	6
Non-Metallic Mineral Products	254h	1	–	1	–
Ore Dressing Laboratory	63	–	3	–	3
Physics of Ore Dressing	64	1	–	1	–
Plant Design	178ha	–	3	–	–
Refractories and Ceramic Bodies	254f	2	–	1	–
Silicate Chemistry	116a	2	–	–	–
Thesis	285	–	3	–	6

DEPARTMENT OF MINING GEOLOGY

(Dept. 9)

The course in Mining Geology is designed to train more particularly those who wish to enter the field of applied geology but it is sufficiently broad to provide training for work in any branch of geology, unless it be in that in which an extensive knowledge of palaeontology is necessary.

The economic geologist is frequently brought into contact with engineering problems and it is essential that he receive a good grounding in those subjects, such as mathematics, mechanics, chemistry, physical sciences, surveying and engineering drawing, that constitute the preliminary work in engineering courses. It is necessary that he understand something of the language and methods of the mining, metallurgical and construction engineer with whom he must co-operate in his work around mines, dams and other engineering works. The first two years of this course are the same as those in Mining Engineering, since that course provides the essential preliminary work, and some mining and metallurgy are taken in the other years to broaden the knowledge of the geologist in the work of those with whom he must co-operate.

A candidate for a degree in Mining Geology will be required to submit satisfactory evidence that he has spent at least six months in field work. This work may consist of prospecting, work around mines, or service on geological field parties.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subject referring to a more detailed description of each, *e.g.*, Analytical Geometry, 238, page 115.

FIRST YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	290	3	–	4	–
Analytical Geometry and.....	238	1	–	2	–
Calculus................	236	2	–	2	–
Business....................	121	–	–	1	–
Descriptive Geometry........	160	1	–	1	–
Dynamics..................	2	2	–	2	–
Electricity.................	135	2	–	2	–
Elementary Petrography......	260a	–	–	2	–
Engineering Problems and Drawing................	166b	–	9	–	12
General Chemistry...........	84	2	–	1	–
Mineralogy..................	256, 258	2	1	–	1
Mining Laboratory...........	50	–	–	–	3
Physical Training............	280	–	2	–	2
Problems and Seminar........		–	3	–	3
Statics......................	1	2	–	2	–
Surveying..................	270, 271	1	6	1	–
Technical English............	122a	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory.........	89, 90	–	6	–	6
Descriptive Geometry........	162	1	–	1	–
Economics and Finance.......	123	1	–	1	–
Electricity..................	143	1	–	1	–
Engineering Problems and Drawing................	167b	–	3	–	10
General Geology..............	198	2	–	1	2
Inorganic Chemistry..........	87a	1	–	–	–
Inorganic Chemistry..........	87b	–	–	1	–
Mechanics of Materials	4	2	–	2	–

SECOND YEAR SUBJECTS DEPT. 9—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Metallurgy	241	–	–	1	–
Mineralogy	261	–	2	–	2
Mining	51, 53	1	3	–	–
Physical Training	280	–	2	–	2
Problems and Seminar		–	3	–	3
Steam Engines	216	1	–	–	–
Surveying	272a, 273	1	6	1	–
Theory of Measurements	65	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	88, 99	1	6	1	3
Assaying	45, 46	1	3	–	3
Economic Geology	202, 203a	1	3	3	3
Geological Field Work	193	–	–	–	–
Historical Geology	195a	2	3	2	3
Metallurgy	243	1	–	1	–
Mining	54	1	–	1	–
Petrography	262, 263	1	2	1	2
Physical Chemistry	98	2	–	2	–
Physics of Ore Dressing	64	1	–	1	–
Structural Geology	198a	2	3	–	3
Survey Camp	275	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Engineering Economics.......	125	–	–	1	–
Field Methods..............	199b	–	3	–	3
Geology of Canada..........	203d	2	–	2	3
Geology, Mining............	199a	2	3	2	3
Geology, Precambrian.......	199	2	–	–	–
Geophysics.................	322	2	6	2	6
Mineralography.............	263b	–	2	–	2
Mining Methods.............	55a	1	–	1	–
Petrographic Methods.......	263a	1	1	1	1
Silicate Chemistry.........	116a	2	–	–	–
Thesis.....................	204a	–	6	–	6

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 1. Applied Mechanics—Statics, means the course of lectures indicated by this number in the table of curriculum for the First Year on page 26.

APPLIED MECHANICS AND DESIGN OF STRUCTURES

1. Applied Mechanics—Statics. T. R. Loudon.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 2 hrs. per week, both terms.

This course of lectures deals with the fundamental principles of the laws of equilibrium of forces. These principles are applied to the determination of stresses in simple structures. Toward the end of the course an introduction to Mechanics of Materials is given.

Text: Analytical Mechanics for Engineers—Seely and Ensign.

2. Applied Mechanics—Dynamics. M. J. C. Lazier.

Departments 1, 2, 3, 6, 7, 8, 8a and 9, I Year; 2 hrs. per week, both terms.

This course of lectures is designed to extend the elementary principles of preparatory school mechanics to a more general viewpoint. Under the heading of Kinematics, the general equations of motion, both linear and angular, are developed.

Centres of mass and moments of inertia are calculated.

The principles of linear and angular momentum are dealt with and a fairly comprehensive course on effective and inertia forces as applied to engineering problems is given. The discussion of energy, work and power is extended as far as possible to practical problems.

Simple Harmonic Motion is also discussed.

Text: Tutorial Dynamics—Briggs and Bryan. Analytical Mechanics for Engineers—Seely and Ensign. Introduction to Mechanics—J. W. Campbell.

3. Applied Mechanics—Dynamics. T. R. Loudon, M. J. C. Lazier.

Department 3, II Year; 1 hr. per week, both terms.

This course of lectures extends the work of the First Year to more general applications, such as: bodies moving with general plane motion, compound pendulum, gyroscopic action. A short discussion of the fundamental theory of hydrodynamics with particular reference to determining stream line flow is included in these lectures.

Texts: Analytical Mechanics for Engineers—Seely and Ensign. Hydromechanics, Part II—Ramsey.

4. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Departments 1, 2, 3, 6, 7, 8, 8a and 9, II Year; 2 hrs. per week, both terms.

In this course, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Reference book: Strength of Materials—Case.

4*a*. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Department 5, II Year; 2 hrs. per week, both terms.

In this course the fundamental theories of stress and strain are discussed and applied to the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. One portion of the course deals with dynamics of rigid bodies, general equations in two dimensions, centre of percussion, the compound pendulum, friction, and simple harmonic motion with friction.

Reference book: Strength of Materials—Case.

5. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Department 4, II Year; 2 hrs. per week, both terms.

This course deals with the mathemactical consideration of stress and elasticity. Among the problems taken up are the consideration of riveted joints, theory of simple and continuous beams, the theory of columns and simple column footings.

Text: Strength of Materials—Boyd.

5*a*. Applied Mechanics—Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Department 5, I Year; 2 hrs. per week, both terms.

This course of lectures deals with the determination of stresses in simple frame structures and beams. The course also includes a discussion of kinematics of particles, accelerated motion, motion on curved paths, the kinematic chain, geometry of simple harmonic motion, kinetics of massive particles, momentum, collision, rotation, moments of inertia, energy, work, power, kinetics of simple harmonic motion, and Bernoulli's equation.

Text book: Analytical Mechanics for Engineers—Seely and Ensign.

5*b*. Applied Mechanics—Advanced Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Department 5, III Year.

This course of lectures deals with accelerations in machines, balancing governors, gyrostatic action, generalised equations, stability of motion, and vibrating systems.

6. Theory of Structures. C. R. Young, C. F. Morrison.

Department 1, III Year; 2 hrs. per week, both terms.

This course is an elementary study of the stress analysis and design of structures, structural members and their details. A number of problems in analysis and design are worked out in the lectures and in the drafting room.

The work in the first term includes a discussion of tension members, steel and timber columns, simple and continuous beams, box girders and plate girders. Welding as a method of connecting structural steel members is studied.

The second term is given chiefly to moving loads, the design of a riveted truss highway span, and the theory of railway truss spans.

Texts: Modern Framed Structures, Part III—Johnson, Bryan and Turneaure. Structural Members and Connections—Hool and Kinne. Elementary Structural Problems—Young. Structural Design in Steel—Shedd. Steel Construction Handbook—A.I.S.C.

7. Theory of Structures. C. F. Morrison.

Departments 2, 3, 5e, 5h, 6 and 8a, III Year; 1 hr. per week, both terms.

The work is practically the same as that for course 6 in the first term.

8. Structural Design. C. F. Morrison.

Department 4, III Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

The stress analysis of simple structures is discussed in this course. Practical problems on the design of beams, columns, piers, footings, and roof trusses are worked out in the drafting room.

Reference book: Architectural Construction—Gay and Parker.

9. Mechanics of Materials. C. R. Young, W. L. Sagar.

Departments 3 and 5, II Year, Department 2, IV Year, 3 hrs. per week, one term; Department 1, III Year, 5 hrs. per week, one term.

This laboratory course is intended to give the student an introduction to the experimental study of the strength and elasticity of materials. It is intended that he shall acquire some familiarity with the construction and operation of testing machines and with the properties of ordinary materials of construction. In addition students in Department 1 conduct a series of experiments designed to give familiarity with the fundamentals of concrete mixtures.

Reference: Junior Laboratory Course in Mechanics of Materials, Department of Civil Engineering; Municipal and Structural.

10. Stress Graphics. C. F. Morrison.

Departments 1 and 5e, III Year; 1 hr. per week, both terms.

This course of lectures deals with graphic methods of determining stresses in framed structures, the construction of shearing force diagrams, bending moment diagrams and influence lines. Some attention is also given to the principles of formula charting.

Text book: Graphic Analysis—Wolfe.

10*a*. Applied Elasticity. J. N. Goodier.

Department 1, III Year; 1 hr. per week, both terms.

The analysis of states of stress and strain of fundamental importance in engineering is developed analytically rather than graphically, aiming at general conclusions of wide applicability, as well as at the establishment of the theorems on which the graphical methods of structural analysis are founded, and the solution of problems to which graphical methods are not appropriate. The topics treated include: tension, torsion, and bending, both static and dynamic (impact and sudden strain); moment-area theorems; the theorem of three moments; built-in beams under concentrated and distributed loads; the general specification of stress and strain; principal stresses and strains; theories of failure; reduction of strain measurements; stress due to uneven heating; the physical significance of the Euler theory of buckling; stress in thick-walled tubes.

10*b*. Applied Elasticity. T. R. Loudon.

Department 5e, IV Year; 1 hr. per week, second term.

Deformations and stresses in plates and slabs variously supported and variously loaded, in railway rails and ties, in footings, in the heads of pressure vessels, and in structures composed of dissimilar materials subjected to temperature changes, shrinkage and flow.

11. Cements and Concrete. C. F. Morrison, W. L. Sagar.

Department 1, III Year; 1 hr. per week, both terms.

Department 8, III Year; 1 hr. per week, first term.

The work in the first term includes a discussion of the cements used in construction, Portland cement in particular, and a study of the basic principles of concrete making.

In the second term the elements of the theory of reinforced concrete are discussed and examples are considered in the design of slabs, beams, and columns.

Texts: Plain Concrete—Bauer. Chemistry of Cement and Concrete—Lea and Desch. Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete Construction, Vol. I—Hool. Design of Concrete Structures—Urquhart and O'Rourke.

12. Theory of Structures. C. R. Young.

Departments 1a and 5e, IV Year; 2 hrs. per week, both terms.

The work comprised in this course of lectures concerns arches, suspension bridges, cantilever bridges, movable bridges, deflections, statically indeterminate systems, and secondary stresses. Problems based on the lectures are worked out in the drafting rooms.

Reference books: Modern Framed Structures, Part II—Johnson Bryan and Turneaure. Theory of Modern Steel Structures, Vol. II—Grinter.

12*a*. Advanced Structural Analysis. C. R. Young, C. F. Morrison.

Department 5e, IV Year; 2 hrs., lecture, and 6 hrs. laboratory per week, both terms.

Flexural deformations are thoroughly investigated by the methods of single and double integration, by moment areas, shear areas, elastic weights, dummy loads, and Castigliano's first theorem. This is followed by a consideration of shear deformations, space structures, applications of the slope-deflection method and modifications of it, applications of the method of moment distribution, with modifications, stress determination by the method of least work, by Castigliano's second theorem, by the ellipse of elasticity method, the column analogy method and the fixed-point method.

13. Mechanics of Materials. C. R. Young, W. L. Sagar.

Department 1a, IV Year; a laboratory course of 3 hrs. per week, both terms.

This course of experiments is intended to give the student practice in investigating the elastic and physical properties of iron, steel, concrete, timber, etc., and in the use of instruments of precision designed for that purpose.

Reference book: Materials of Construction—Johnson.

13*a*. Engineering Mechanics. The staff in Civil Engineering.

Department 5e, IV Year; 6 hrs. per week laboratory, both terms.

Elastic properties of the materials of construction. Experimental determination of the elastic behaviour of, and stresses in, members and structures by means of mechanical and optical models.

14. Foundations, Retaining Walls and Dams. T. R. Loudon, W. J. Smither.

Department 1a, IV Year; 1 hr. per week, both terms.

This course of lectures is devoted to the design of the structures mentioned. The most approved forms of construction of retaining walls, footings, abutments, piers and dams are described, and typical designs are worked out in the class and drafting rooms.

Text books and books of reference: Retaining Walls for Earth —M. A. Howe. Walls, Bins and Grain Elevators—M. S. Ketchum. Design and Construction of Dams—E. Wegmann.

14*a*. Soil Mechanics. W. L. Sagar.

Department $1a_1$ and $1a_2$, IV Year; 1 hr. lecture per week, first term.

A course of lectures devoted to those physical and mechanical properties of soils of importance to the engineer, such as compressive and cohesive strengths, internal friction, stability in slopes, compressibility and other deformational characteristics, permeability and moisture retention. The bearing of these properties on the design and construction of engineering works is considered in detail.

Reference books: Engineering Properties of Soil—Hogentogler. Notes on Soil Mechanics and Foundations—Plummer.

15. Reinforced Concrete. C. R. Young.

Department 1a, IV Year; 1 hr. per week, both terms.

The theory of the strength of reinforced concrete elements including the beam, the slab, the T-beam, the column and the girderless floor, is continued in this course.

The analysis of the monolithic arch by the elastic theory is discussed, and the student is required in the drafting room to apply his knowledge to the design of simple structures.

Reference books: Principles of Reinforced Concrete Construction—Turneaure and Maurer. Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete—Caughey.

16. Structural Design. C. F. Morrison.

Department 4, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

In this course the properties of the materials used and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of slabs, beams, columns and footings are made. The lectures are supplemented by the working of problems in the drafting room.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Architectural Construction—Gay and Parker.

17. Structural Design. C. R. Young, W. J. Smither.

Department 1a, IV Year; 1 hr. per week, both terms.

Department 3, IV Year; 1 hr. per week, first term.

In this course of lectures consideration is given to such matters as mill construction buildings, economic arrangement of building frames, probable loadings for girders and columns, column eccentricities, crane runways, cable ways, wind bracing, and rigid frames.

Text books: Handbook of Building Construction—Hool and Johnson. Architects' and Builders' Handbook—Kidder-Parker.

18. Structural Design. W. J. Smither, C. F. Morrison.

Departments 1a, and 3, IV Year; 1 hr. per week, first term.

Consideration is given in this course to the various types of mill buildings, to the conditions governing their choice and to the design and details of construction in different materials. Designs of portions of mill buildings are worked out in the class and drafting rooms.

Text books: Steel Mill Buildings—Ketchum. Mill Buildings—Tyrrell.

19. Miscellaneous Structures. W. J. Smither.

Department 1a, IV Year; 1 hr. per week, second term.

In this course of lectures the application of theoretical principles to the design of a variety of structures is made. Among those structures discussed are transmission line towers, elevated tanks and their supporting towers, standpipes, large pressure pipes, sewers, culverts, small highway bridges, sub-surface tanks, aircraft structures and tall chimneys. Whenever possible the lecture work is followed up by designs in the drafting room.

20. Reinforced Concrete. C. F. Morrison.

Department 3, IV Year; 1 hr. per week, first term.

In this course the properties of the materials involved and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of columns, beams, floors and footings are made.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete Construction, Vol. I—Hool. Design of Concrete Structures—Urquhart and O'Rourke.

21. Structural Design. T. R. Loudon.

Department 4, V Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

In this course the students apply the principles of structural design to problems in which actual buildings are designed and detailed.

23. Vibration Engineering. M. J. C. Lazier.

Department 5e, IV Year; 1 hr. per week, both terms.

Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

23*a*. Vibration Laboratory. M. J. C. Lazier.

Department 5e, IV Year; 3 hrs. per week, both terms.

A series of experiments designed to give familiarity with the nature of vibrating systems and the causes, measurement and control of vibration in engineering problems. The assignment of experiments will depend on whether the student has elected for special study (*a*) Vibration of Structures, or (*b*) Vibration of Machines.

ARCHITECTURE, DRAWING AND PAINTING

25. History of Architecture. H. J. Burden.

Department 4, I Year; 1 hr. per week; both terms.

In this course the development of architecture and ornament is traced from pre-historic times to the close of the Byzantine Period.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. The Architecture of Ancient Greece—Anderson, Spiers, and Dinsmoor. The Architecture of Ancient Rome—Anderson, Spiers, and Ashby. The Grammar of Ornament—Owen Jones.

25*a*. History of Architecture. H. J. Burden.

Department 4, II Year; 1 hr. per week; both terms.

In this course the development of architecture and ornament is traced from the Romanesque Period to the end of the Gothic Period.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. Medieval Architecture—Arthur Kingsley Porter. Gothic Architecture in England — Francis Bond. The Grammar of Ornament—Owen Jones.

25*b*. History of Architecture. H. H. Madill.

Department 4, III Year; 1 hr. per week, first term.

In this course the architecture of the Renaissance in Italy and France is taken in detail.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. Architecture of the Renaissance in Italy—Anderson and Stratton. The Architecture of the Renaissance in France, Vol. 1 and 2—W. H. Ward. The Renaissance of Roman Architecture—T. G. Jackson.

25*c*. History of Architecture. E. R. Arthur.

Department 4, III Year; 1 hr. per week, second term.

This course of lectures covers the period 1500-1900 in England. Lectures on furniture are given in this course with special reference to the development of furniture in England from Mediaeval times.

Reference books: Growth of the English House—J. Alfred Gotch. A History of Renaissance Architecture in England, Vol. 1 and 2—R. Blomfield. History of Domestic Architecture in Britain during

the Tudor Period—Thomas Garner and Arthur Stratton. Houses of the Wren and Early Georgian Period—Turnstall Small and Christopher Woodbridge. Mouldings of Wren and Georgian Periods—T. Small and C. Woodbridge. Robert Adam and his Brothers—John Swarbrick.

26. Functional Requirements of Buildings. A. S. Mathers.

Department 4, III and IV Years; 1 hr. per week, both terms.

In this course of lectures the principles underlying the planning of such large buildings as churches, departmental stores, theatres, schools, railway stations, etc., are discussed in detail.

27. Garden Design. H. B. Dunington Grubb.

Department 4, III Year. Special lectures, first term.

In this course the historical development of Garden Design is traced from earliest times; the study of sites; the influence of topography, orientation, access, etc., on the problems of design; site planning; the location of buildings; the solution of an actual problem on a typical site.

27*a*. Garden Design. H. B. Dunington Grubb.

Department 4, IV Year. Special lectures, first term.

The work of the previous year is continued and a problem is set in the studio involving principles of both architectural and garden design.

28. Elements of Architectural Form. E. R. Arthur.

Department 4, I Year; 1 hr. per week, both terms.

The elements of architectural form include the study of doors, windows, columns, wall treatment, roofs, mantels, chimney stacks, etc. These are examined without regard to particular style and from the standpoint of design rather than construction.

Reference books: Theory and Elements of Architecture, Vol. 1, Part 1—Robert Atkinson and Hope Bagenal. Fragments Antique, Vol. I and II—D'Espouy. The English Fireplace—L. A. Shuffrey. The Design of Lettering—Egon Weiss. Current Architectural Magazines.

30. History of Fine Art. C. W. Jefferys.

Department 4, IV Year; 1 hr. per week, both terms.

The course consists of an outline of the history and development of painting and of the minor pictorial arts from the earliest time until the present day, followed by an outline of the history and development of the different eras of sculpture ranging from the primitive to the present day.

31. Architectural Design. H. H. Madill, E. R. Arthur, W. E. Carswell.

Department 4, I Year. 12 hrs. per week, both terms.

This comprises work done in the studio, including lettering, drawing, and rendering such elementary studies as a door, a window, etc., and exercises in simple composition.

An elementary design is carried to the stage of working drawings. Furniture, mantels, etc., in the Royal Ontario Museum are drawn to scale.

31*a*. Architectural Design. E. R. Arthur, Mackenzie Waters, W. E. Carswell.

Department 4, II Year. 15 hrs. per week, both terms.

This course is given by means of individual instruction in the studio, and by criticism of the solutions of different problems set during the year. It is in this course that the student begins the serious study of design; continued practice in architectural drawing and rendering affords the training necessary to make the student a proficient draughtsman.

31*b*. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4, III Year. 20 hrs. per week, both terms.

This course is given by individual instruction in the studio and by criticism of solutions of problems set during the year. The greater part of the course is devoted to problems in design and forms a continuation of the course given in the preceding year.

One of the students' designs of a building is carried through to the stage of working drawings.

31*c*. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4, IV Year. 20 hrs. per week, both terms.

This course is a continuation of the work of the preceding years, being given by individual instruction in the studio and criticisms of the solution of problems set during the year.

31*d*. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4, V Year. 26 hrs. per week, both terms.

The course of the preceding year is continued in more advanced problems.

One of the students' designs of a building is carried through to the stage of working drawings.

31*e*. Architectural Engineering. H. H. Madill, T. R. Loudon.

Department 4, IV Year; Architectural Engineering Option.

In this course lectures on structural design and layout are given and problems are worked out in the studio. The work is coordinated with problems set in architectural design.

31*f*. Architectural Engineering. H. H. Madill, T. R. Loudon.

Department 4, V Year; Architectural Engineering Option.

In this course the design and preparation of working drawings and structural details of work of a monumental character are carried on in the studio. The student is also required to take such lectures as are prescribed from time to time. The work is coordinated with problems set in architectural design.

32. Theory of Architectural Planning. E. R. Arthur.

Department 4, II Year.

In this course the general principles of planning of buildings from the small to complex problems are demonstrated. In the Second Term actual plans of libraries, banks, houses, etc., are studied as an aid to problems in design and a preliminary to work in the following year.

Reference books: Elements of Form and Design in Classic Architecture—Arthur Stratton. The Modern House—F. R. S. Yorke. The Smaller English House of the Later Renaissance, 1660-1830—A. E. Richardson and H. D. Eberlein. The Plan Requirements of Modern Buildings—V. O. Rees.

33. Architectural Composition. E. R. Arthur.

Department 4, III Year.

This course consists of a series of lectures on the theory of architectural design, the analysis of composition, proportion, scale, etc.

Illustrated lectures are given on Modern Architecture.

Reference books: Principles of Architectural Composition—Howard Robertson. Modern Architectural Design — Howard Robertson. The Architecture of Humanism—Geoffrey Scott. The Gothic Revival—Kenneth Clark. Towards a new Architecture—Le Corbusier. The Study of Architectural Design—J. F. Harbeson. Current magazines from England, France, Italy, Germany and the United States which are available to the students in the School Library.

34. Architectural Aspects of Town Planning. E. R. Arthur.

Department 4, V Year; 1 hr. per week, second term.

In this course of lectures the historical development of town planning is traced with particular reference to the Axial Planning of the Renaissance, public squares, the grouping of buildings and the placing of monuments and street Architecture.

35. Freehand Drawing and Water Colour Painting. H. J. Burden, W. E. Carswell.

Department 4, I Year; 2 hrs. per week, both terms.

Drawing from still life, primary free hand perspective, primary pencil, charcoal, and pen and ink rendering.

35*a*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Department 4, II Year; 2 hrs. per week, both terms.

Drawing and monochrome painting from still life, drawing from the cast, pencil, pen and ink, and monochrome rendering, primary water colour, drawing from landscape and natural objects.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*b*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Department 4, III Year; 2 hrs. per week, both terms.

Drawing from the cast, water colour from still life, water colour rendering, drawing from landscape and natural objects.

Students who are sufficiently advanced are admitted to the Fourth Year Life Drawing Class.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*c*. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Departent 4, IV Year; 2 hrs. per week, both terms.

Water colour from still life and from landscape, drawing from life.

In addition to the periods sets out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the camp on the date shown on page 5.

35*d*. Water Colour and Life Drawing. C. W. Jefferys.

Department 4, V Year; 2 hrs. per week, both terms.

Advanced water colour drawings and murals; drawings from life.

36. Modelling. Frederick Coates.

Department 4, II Year; 2 hrs. per week, both terms.

Scale models of architectural forms.

36a. Modelling. Frederick Coates.

Department 4, III Year; 2 hrs. per week, both terms.

Scale models of simple buildings.

36*b*. Modelling. Frederick Coates.

Department 4, IV Year; 2 hrs. per week, both terms.

Scale models of buildings and settings.

37. Building Construction. H. H. Madill.

Department 4, I Year; 1 hr. per week, second term.

Instruction is given in elementary construction using common building materials. The detailing of doors, windows, roofs, etc.

Reference books: Architectural Building Construction, Vol. 1—Jaggard and Drury. Building Construction, Vol. 1—V. F. Mitchell. Architectural Graphic Standards—Ramsey and Sleeper.

38. Building Materials. H. H. Madill.

Department 4, IV Year; 2 hrs. per week, both terms.

Properties and the use of the various materials used in building are studied from the architectural rather than the structural viewpoint.

A small exhibition room has been set aside in which examples of the most modern materials and devices are displayed. This room is open to the student at all times.

Reference books: Architectural Construction, Vol. 1—Voss and Henry. Builders Materials—R. F. B. Grundy. Brickwork—W. R. Jaggard. Lumber and its uses—R. S. Kellog. Building Construction, Vol. 1 and 2—Jaggard and Drury. Rivingtons Notes on Building Construction, Part I and II—W. N. Twelvetrees.

39. Sanitary Science. H. H. Madill.

Department 4, IV Year; 1 hr. per week; both terms.

Modern plumbing, its design and installation, drainage, sewerage disposal and water supply.

Reference books: Mechanical and Electrical Equipment for Buildings—Gay and Fawcett.

39*a*. Professional Practice. H. H. Madill.

Department 4, V Year; 1 hr. per week, both terms.

This course of lectures is designed to give an understanding of the professional character of the practice of architecture. In it are discussed the ethical, business and legal relations of the architect to clients, contractors, craftsmen, engineers and the professional bodies. The methods of office practice are also discussed.

Reference books: Architectural Practice and Procedure—H. H. Turner. The Architects Law Manual—C. H. Blake. The Law of Architecture and Building—C. H. Blake. Handbook of Architectural Practice A.I.A. Contract Forms of R.A.I.C. Code of Architectural Competitions O.A.A. Standard Specifications A.I.A.

40. Heating and Air Conditioning. A. Wardell.

Department 4, V Year; 1 hr. per week, both terms.

In this course of lectures the different systems of heating, ventilating and air conditioning of buildings are discussed.

40*a*. Architectural Economics. W. S. Wilson.

Department 4, V Year; 1 hr. per week, both terms.

A course of instruction in the various methods of preparing estimates, together with practical work in taking off quantities.

41. Vacation Work. H. H. Madill.

Department 4, II Year.

Each student is required to submit a set of twenty pages of notes on building construction on or before the opening day of the session. These notes are to consist of freehand pencil drawings with figured dimensions. Instruction as to the nature of these notes will be given by Prof. Madill before the close of the previous session.

42. Vacation Work. E. R. Arthur.

Department 4, III Year.

Each student is required to submit on or before the opening day of the session a set of measured drawings of existing buildings, and details of buildings, the building first to be approved by Prof. Arthur, who will also decide the number and size of the drawings to be made. The record of measurements must be preserved in a notebook which will be submitted with the final drawings.

43. Vacation Work. H. J. Burden, W. E. Carswell.

Department 4, IV Year.

Each student is required to submit on or before the opening day of the session a set of at least seven outdoor sketches in water colour, pen and ink, or pencil. The minimum size for each sheet will be $9'' \times 12''$. Of these sketches at least four will be in pencil and at least three will be of an architectural character.

44. French. Miss J. C. Laing.

Department 4, I Year; 2 hrs. per week, both terms.

A. Reading of texts illustrative of French life; brief study of the geography of France.

B. Outline of the History of France with reference to the development of French Civilization, particularly Architecture.

Text book: Michelet's Histoire de France—Buffum.

Reference books: The Ordeal of Civilization—James Harvey Robinson. History of Medieval Europe—Thorndike. A History of France—William S. Davis. A short History of France, A Short History of Italy—Henry Dwight Sedgwick. Autobiography—B. Cellini. Leonardo da Vinci—Merejowski.

44*a*. French. Miss J. C. Laing.

Department 4, II Year; 1 hr. per week, both terms.

Continuation of the work of the I Year.

Reference books: The Renaissance and the Reformation—Lucas. A Political and Cultural History of Modern Europe, Vol. 1—Hayes. A Short History of France, National History of France, The Century of the Renaissance—Batiffol. The Seventeenth Century—Boulenger.

ASSAYING, MINING AND ORE DRESSING

The work in Mining is directed more to the development of the proper attitude of mind towards mining problems than to the teaching of actual mining methods.

The teaching of Assaying has a two-fold function. The first is to give the student a working knowledge of the practice of the art, so that he can earn money as an assayer on graduation and use this as a stepping-stone to other positions. The second is to use the assaying laboratories for the training of students in certain important phases of engineering methods. The size of the apparatus, the completeness of the processes in short intervals of time, the extreme accuracy of results when so desired, the relation of the extent of error to time and method, the similarity of the academic laboratory to the field laboratory—all these permit an unrivalled opportunity for driving home much broad engineering philosophy. The assaying processes and apparatus lend themselves peculiarly well to the development of a proper perspective in regard to errors and accuracy in measurements.

The study of Ore Dressing, when accompanied by laboratory work in a well-equipped ore dressing laboratory, is one of the most important of the Mining Engineering subjects. Not only is the mechanical treatment of ores a very important branch of Mining Engineering, but the mental processes involved in a study of the fundamental principles underlying the art, and the compromise necessary for field practice form one of the best fields for the development of engineering philosophy. From these points of view, the ore dressing laboratory is exceptionally well equipped.

45. Assaying. J. T. King.

Departments 2, 8 and 9, III Year; 1 hr. per week, first term.

A first course of lectures on the theory of fire assaying. Emphasis is laid not only on the chemical and metallurgical principles involved, but upon the errors inherent in operators as well as in methods.

Text Book: Manual of Fire Assaying—Fulton and Sharwood.

46. Assaying. J. T. King.

Departments 2, 8 and 9, III Year; 3 hrs. per week, both terms.

A laboratory course in the determination of the precious metals in ores, milling and metallurgical products. Scorification and crucible assays of ores and products, pure and impure, fluxes, slags and solutions. Buckboard practice, ores with metallics. Copper and lead by electrolysis. Students are expected to do their later assays with despatch and a reasonable degree of accuracy. Neatness of work is required.

47. Assaying. J. T. King.

Departments 2 and 8, IV Year; 1 hr. lecture per week, second term.

A continuation of course 45. Complex ores. Combination assays. The sampling and assay of bullion. The platinum group metals. Checks and corrections.

48. Assaying. J. T. King.

Departments 2 and 8, IV Year; 3 hrs. per week, second term.

An advanced laboratory course in which some of the methods of course 47 are used.

49. Assaying. J. T. King.

Department 6, III Year; 3 hrs. per week, first term.

An introductory laboratory course for chemical engineers. Some lecture instruction is given. An abbreviation of courses 45 and 46.

50. Mining. H. E. T. Haultain, F. C. Dyer.

Departments 2 and 9, I Year; 3 hrs. per week, second term.

A laboratory course, including some lectures, being an introduction to certain mining and milling machinery and methods.

51. Mining. H. E. T. Haultain.

Departments 2, 8 and 9, II Year; 1 hr. per week, first term.

An introductory course of lectures.

52. Mining. H. E. T. Haultain.

Department 8, II Year; 1 hr. per week, second term.

An extension of course 51.

53. Mining. F. C. Dyer.

Departments 2 and 9, II Year; 3 hrs. per week, first term.

A continuation of course 50. Rock drills, sampling methods, use of explosives.

54. Mining. H. E. T. Haultain, F. C. Dyer.

Departments 2 and 9, III Year; 1 hr. per week, both terms.

Principles of mining.

55. Mining. H. E. T. Haultain.

Department 2, IV Year; 1 hr. per week, both terms.

Special problems, estimates, reports.

55*a*. Mining Methods. H. E. T. Haultain.
Department 9, IV Year; 1 hr. per week, both terms.
Mining methods.

56. Mine Cost Finding and Management. H. E. T. Haultain.
Department 2, IV Year; 1 hr. per week, both terms.
One of the fundamental features that must not be lost sight of by the mining engineer is, that his work is designed primarily for purposes of financial profit. This course of lectures deals with details from this point of view. The total cost of a ton of ore requiring as it does an understanding of the problems of amortization, is first dealt with in a broad way. Then are considered various problems of cost finding, leading on to problems of time and motion study which are essential to the development of the fine points of the art in any particular mining problem. The latter part of the course deals with problems of management, the relation of members of the staff to each other, and the relations of the staff to labour.

57. Mine Ventilation and Allied Problems. The Staffs in Mining and Mechanical Engineering.
Department 2, IV Year; 2 hrs. lectures and 3 hrs. laboratory per week, first term.

58. Ore Dressing. H. E. T. Haultain, F. C. Dyer.
Departments 2 and 8, III Year; 1 hr. per week, both terms.
The general principles of Ore Dressing.

59. Ore Dressing. F. C. Dyer,
Departments 2 and 8, III Year; 6 continuous hrs. per week, second term.
Work with crushing machinery, principles of crushing and grading, screen analyses, concentration with gravity separation apparatus, etc.

60. Ore Dressing. H. E. T. Haultain, F. C. Dyer.
Departments 2 and 8, IV Year; 1 hr. per week, both terms.
Course 58 continued, study of flow sheets and special problems.

61. Ore Dressing. F. C. Dyer.
Departments 2 and 8, IV Year; 6 continuous hrs. per week, first term.
Advanced work with ore dressing appliances, ore testing and check mill runs.

62. Ore Dressing. F. C. Dyer.
Department 6m, IV Year; 1 hr. per week, both terms.
General principles of Ore Dressing.

63. Ore Dressing. F. C. Dyer.

Department 6m, IV Year; 1 period of 6 hrs. per week, second term.

Department 8a, IV Year; 3 hrs. per week, both terms.

Principles of sampling, crushing and grading, screen analyses, concentration with gravity separation apparatus, flotation, ore testing, etc.

64. Physics of Ore Dressing. F. C. Dyer.

Departments 2, 8 and 9, III Year and Departments 6m and 8a, IV Year; 1 hr. per week, both terms.

Ore dressing methods involve a study of the laws governing the phenomena of surface tension, capillarity and colloidal solutions, in addition to those of hydrostatics and certain phases of hydraulics. This is embodied in a special course of lectures in conjunction with laboratory work in the ore dressing laboratory.

65. Theory of Measurements. H. E. T. Haultain, F. C. Dyer.

Departments 2 and 9, II Year; 1 hr. per week, first term.

This title is not an entirely suitable one for this course of lectures because it is generally applied to a study of the philosophy of extremely accurate measurements. The mining engineer has to continually make satisfactory use of measurements with a wide range of inaccuracy. This course of lectures deals with the philosophy underlying the causes of these errors and the practical application of such approximations. The opportunity is taken in these lectures to deal with the subject of illustrating measurements by graphs.

66. Introductory Research. H. E. T. Haultain, F. C. Dyer.

Department 2, III Year; 3 hrs. per week, first term.

This is a laboratory course including some lectures and is a preparation for the thesis of the Fourth Year.

67. Thesis.

Department 2, IV Year; 7 hrs. per week, first term; 10 hrs. per week, second term, in continuous periods.

Thesis in this department consists mainly in reports on original work done in the laboratories. In the Third Year the subject "Introductory Research" paves the way for the thesis. By October 15th the student decides on the subject of his thesis in consultation with his professors. After this is decided the student uses his own initiative in the development of his work.

The thesis is divided into three parts. The first part, which is handed in not later than October 15th, contains the title, a statement of what the title is meant to convey and an outline of the work that is proposed to be done. The second part is handed in during the first week of January and contains a report of progress to date and enables the professor in charge to keep in closer touch with the work. The third and final part is handed in a week before the examinations and is a report of progress to date with final conclusions. The three parts combined constitute the thesis.

69. Vacation Work. H. E. T. Haultain.

Department 2, III Year.

This is a series of letters written during the summer vacation, dealing with various aspects of a mining engineer's work. These are intended to direct and help the student's powers of observation, analysis and criticism as well as being exercises in the art of lucid technical expression.

Special instructions will be issued in connection with these letters.

70. Vacation Work. H. E. T. Haultain.

Department 2, IV Year.

Special instructions will be given in connection with this work.

ASTRONOMY AND GEODESY

71. Astronomy, Elementary. P. M. Millman.

Department I, II Year; 1 hr. per week, both terms.

A course in descriptive Astronomy, explaining the ordinary astronomical terms, and describing the various celestial bodies and their motions. In the evenings opportunity will be given for identifying the stars and for observing with telescopes.

Text book: Elements of Astronomy—Fath.

72. Astronomy and Geodesy. S. R. Crerar.

Department 1, III Year; 2 hrs. per week, both terms.

The course of lectures deals with the determination of time, latitude, longitude and azimuth, by methods adapted to the use of the surveyor's transit and the sextant. It is designed to fulfil the requirements of the final examinations for Ontario and Dominion Land Surveyors.

In Geodesy an account is given of the principles and methods of a secondary triangulation survey, also of the principles involved in the North-west system of survey.

Text books: Practical Astronomy as applied to Geodesy and Navigation—Doolittle. Notes on Practical Astronomy and Geodesy. Nautical Almanac.

73. Field Work. S. R. Crerar.

Department 1, III Year; about 2 hrs. per week, first term.

The practical work in this subject comprises observations in the field with the transit and sextant for the determination of time, latitude and azimuth by the methods described in the lectures and the solution of related problems.

74. Astronomy (Advanced). J. W. Melson.

Department 1b, IV Year; 2 hrs. per week, both terms.

The lecture course in this subject comprises the theory and adjustment of the instruments used in connection with a geodetic survey; the methods of taking and reducing observations for time, longitude, latitude, and azimuth. with the precision required on such a survey; and other matters relating to these subjects.

75. Geodesy and Metrology. W. M. Treadgold.

Department 1b, IV Year; 2 hrs. per week, both terms.

The lecture course includes a description of the methods of measuring base lines and the angles of a triangulation; the geometry of the spheroid with applications to geodetic problems; the computation of geodetic positions; the solution of large triangles on the earth's surface, and the adjustment of a triangulation; trigonometric and precise spirit levelling; the determination of the figure of the earth by arc measurements, and by the pendulum; the theory of map projections, etc.

76. Astronomy, Geodesy and Metrology. W. M. Treadgold, J. W. Melson.

Department 1b, IV Year; about 23 hrs. per week, both terms.

The practical work in the above subjects includes the observation of meridian transits for time and longitude determinations, and of prime vertical transits for latitude, with the astronomical transit instrument; the observation of meridian zenith distances of stars, and of azimuths at elongation for latitude, with the alt-azimuth; theodolite observations for azimuth; observations for latitude with the zenith telescope; the investigation of the constants of the instruments used, and the reduction of all observations; the measurement of a base line with the steel tape and with invar wires, and the determination of the constants of the tape; the measurements of the angles of a triangulation and the adjustment of the angles of network of triangles, etc. A portion of this work will be taken at the University Survey Camp. (See course 275.)

BIOLOGY

80. Elementary Biology. A. J. V. Lehmann.

Department 6, I Year; 3 hrs. per week, second term.

A lecture and laboratory course on biological principles.

CHEMISTRY AND CHEMICAL ENGINEERING

84. General Chemistry. E. G. R. Ardagh.

Departments 1, 2, 3, 7 and 9, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

An advanced course in inorganic chemistry with industrial applications.

85. General Chemistry. E. A. Smith.

Deparments 5, 6, 8 and 8a, I Year; 2 hrs. per week, first term; 1 hr. per week, second term.

An advanced course in chemical theory with industrial applications.

86. Inorganic Chemistry. L. J. Rogers.

Department 5, I Year; 3 hrs. per week, both terms.

Department 6, I Year; 12 hrs. per week, both terms.

Department 8a, I Year; 9 hrs. per week, first term; 15 hrs. per week, second term.

A laboratory course of quantitative experiments illustrating the use of the sensitive balance, and confirming the fundamental laws of chemistry; qualitative inorganic analysis; quantitative analysis of pure salts.

Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

87*a*. Inorganic Chemistry A. E. G. R. Ardagh.

Departments 1, 2, 3, 6, 7, 8, 8a and 9, II Year; 1 hr. per week, first term.

A continuation of courses 84 and 85 dealing principally with the metals.

87*b*. Inorganic Chemistry B. E. G. R. Ardagh.

Departments 2, 6, 8, 8a and 9, II Year; 1 hr. per week, second term.

A continuation of courses 84 and 85.

Text book: General Chemistry—Deming.

88. Analytical Chemistry. L. J. Rogers.

Departments 2, 6, 8, 8a and 9, III Year; 1 hr. per week, both terms.

A lecture course on the principles of chemical analysis; select gravimetric and volumetric methods; technical analysis.

89. Analytical Chemistry. E. A. Smith, R. R. McLaughlin.

Departments 1 and 3, II Year; 6 hrs. per week, second term.

Departments 2 and 9, II Year; 6 hrs. per week to Dec. 1st.

Department 7, II Year; 6 hrs. per week, first term.

Laboratory course in qualitative and quantitative analysis.

90. Analytical Chemistry. E. A. Smith.

Departments 2 and 9, II Year; 6 hrs. per week, from Dec. 1st.

A laboratory course in the gravimetric determination of metals and acids, with elementary volumetric analysis.

91. Analytical Chemistry. L. J. Rogers.

Department 8, II Year; about 14 hrs. per week, first term; about 13 hrs. per week, second term.

A laboratory course comprising gravimetric and volumetric methods, acidimetry and alkalimetry.

Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

92. Analytical Chemistry. L. J. Rogers.

Department 6, II Year; about 100 hrs., to Dec. 1st.

Department 8a, II Year; 10 hrs. per week, first term; 8 hrs. per week, second term.

A laboratory course in quantitative chemical analysis; inorganic preparations.

Text book: Analytical Chemistry, Vol. II—Treadwell-Hall.

93. Engineering Chemistry. E. A. Smith.

Departments 1, 3, 5, 6, 7 and 8a, II Year; 1 hr. per week, first term.

A lecture course consisting of a study of the industrial production and application of heat, and of the chemistry of fuel and the products of combustion.

94. Industrial Chemistry. J. W. Bain.

Departments 6 and 8a, II Year; 1 hr. per week, both terms.

A lecture course on the manufacture of salts, acids, alkalies and inorganic chemicals.

94*a*. Industrial Chemistry and Technical Analysis. E. G. R. Ardagh.

Departments 6 and 8a, II Year; about 70 hrs., second term.

An introductory laboratory course in industrial chemistry containing experiments on petroleum products, fertilizers, etc., preparation of inorganic salts on a pound scale.

95. Organic Chemistry. M. C. Boswell.

Departments 1 and 3, II Year; 1 hr. per week, second term.

A lecture course upon some of the elementary principles of Organic Chemistry and their application to selected industries.

96. Industrial and Laboratory Synthesis in Organic Chemistry. M. C. Boswell.

Department 6, II Year; 2 hrs. per week, both terms.

A discussion of the chemical reactions used in synthesis in the laboratory and the factory, and of the conditions under which compounds are brought into reaction, the conditions used for securing high yields, and the methods employed for isolating compounds from reaction mixtures both in the laboratory and in industry.

97. Industrial and Laboratory Methods of Synthesis. M. C. Boswell, R. R. McLaughlin.

Department 6, II Year; about 115 hrs., second term.

A laboratory course accompanying lecture course 96.

98. Physical Chemistry. F. B. Kenrick.

Departments 5, 6 and 8a, II Year; Department 9, III Year; 2 hrs. per week, both terms.

A course of lectures on the elements of chemical mechanics, and the theory of solutions.

99. Analytical Chemistry. L. J. Rogers.

Departments 2 and 9, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.

A laboratory course on the technical analysis of ores and furnace products.

100. Industrial Chemistry and Technical Analysis. E. G. R. Ardagh.

Departments 6 and 8a, III Year; 155 hours.

A continuation of laboratory course 94a, containing experimental work on coal, petroleum, illuminating gas, silicates, sugars, starch, etc., potentiometric determination of hydrogen-ion, preparation of inorganic salts on a pound scale. Instruction in glass blowing is given in this course.

Text book: American Society for Testing Materials. Engineering Chemistry—Stillman. Liquid and Gaseous Fuels—Lewes and Kershaw. Fuels and their Combustion—Haslam and Russell. Determination of Hydrogen Ions—Clark. Technical Methods of Chemical Analysis—Lunge. Handbook for Cane Sugar Manufacturers—Spencer.

101. Analytical Chemistry and Phase Rule. L. J. Rogers, J. T. Burt-Gerrans.

Department 8, III Year; about 6 hrs. per week, second term.

A laboratory course in analysis and phase rule.

102. Engineering Chemistry. J. W. Bain, E. G. R. Ardagh.

Departments 1, 2, 3, 6, 7, 8 and 8a, III Year; 1 hr. per week, both terms.

A lecture course on the application of chemistry to engineering problems: air, water, corrosion of metals, explosives, petroleum products, rubber, synthetic resins, etc.

103. Industrial Chemistry. E. G. R. Ardagh.

Department 6, III Year; 1 hr. per week, both terms.

A lecture course on petroleum and its products, coal tar and its products, fats, oils, soap, sugar, starch, rubber, fermentation industries, etc.

104. Chemical Engineering. J. W. Bain.

Departments 6 and 8a, III Year; 1 hr. per week, both terms.

A lecture course on the theory and practice of heat transfer, evaporation, filtration and other industrial operations.

Text book: Elements of Chemical Engineering—Badger and McCabe.

104*a*. Chemical Engineering. Staff in Chemical Engineering.

Department 6, III Year.

A laboratory course in Chemical Engineering introductory to Course 111.

105. Industrial and Laboratory Synthesis in Organic Chemistry. M. C. Boswell.

Department 6, III Year; 2 hrs. per week, both terms.

A continuation of Lecture Course 96.

106. Industrial and Laboratory Methods of Synthesis in Organic Chemistry. M. C. Boswell, E. A. Smith, R. R. McLaughlin.

Department 6, III Year; 125 hrs.

Laboratory and industrial reactions are performed, in some cases using the following small scale industrial apparatus: filter press, sulphonator, tanks for precipitation, electric stirrer, vacuum evaporator, vacuum drier, fusion pot, ball mill, high pressure autoclaves, pumps for transferring liquids, and materials for constructing electric tube furnaces and thermocouples.

Text books: Manual of Industrial Chemistry (Organic)—Rogers. Practical Methods of Organic Chemistry—Gattermann. Unit Processes in Organic Synthesis—Groggins. Die Methoden der organischen Chemie—Houben-Weyl.

107. Electrochemistry. J. T. Burt-Gerrans.

Departments 6 and 8, III Year; 2 hrs. per week, first term.

A lecture course on elementary electrochemistry, illustrated by experiments.

108. Electrochemistry. J. T. Burt-Gerrans.

Departments 6 and 8, III Year; 3 hrs. per week, first term.

A laboratory course in quantitative measurements to accompany course 107.

109. Inorganic Chemistry. J. W. Bain.

Department 6, IV Year; 2 hrs. per week, both terms.

A lecture course on chemical theory.

110. Catalysis in Organic Chemical Industry. M. C. Boswell.

Department 6, IV Year; 1 hr. per week, both terms.

This lecture course is a continuation of Courses 96 and 105 and embraces as well a discussion of the methods used in several of the industries employing catalysts.

110*a*. Organic Chemistry. M. C. Boswell.

Department 8a, II Year; 1 hr. per week, both terms.

Departments 5s and 5g, IV Year; 1 hr. per week, both terms.

A lecture course on the general reactions and methods of synthesis of carbon compounds.

Text book: Organic Chemistry—Perkin and Kipping.

111. Chemical Engineering and Industrial Organic Chemistry. Staff in Chemical Engineering.

Department 6, IV Year.

A laboratory course involving quantitative measurements employing the following standard apparatus: still, heat interchanger, absorption column, and filter press. The experiments have been selected to furnish experimental data for the confirmation of some of the principles and mathematical expressions discussed in Lecture Course 104. The course also includes experiments in industrial chemistry supplementary to Course 106.

Text books: Elements of Chemical Engineering—Badger and McCabe. Distillation Principles and Processes—Sydney Young.

112. Industrial Chemistry and Chemical Engineering. J. W. Bain.

Department 6i, IV Year; 1 hr. per week, both terms.

A lecture course on selected subjects in chemical technology and chemical engineering.

113. Research. The senior staff in Chemical Engineering.

Department 6, IV Year.

In this course, which occupies about three-quarters of the total time of the year, a research problem is given to each student. This provides experience in searching the primary sources of scientific information and in devising analytical methods and designing apparatus applicable to the new problems. Each student is obliged to write a thesis embodying the results of his search of the original literature and his own experimental work. Thus this course serves as a preparation for the field of research work; and those students who, by ability, taste, and temperament, are fitted for research pass naturally either into industrial research or into the graduate school of the University to pursue further work in this field.

114. Electrochemistry. J. T. Burt-Gerrans.

Department 6e, 7e, and 8, IV Year; 2 hrs. per week, both terms.

An advanced lecture course on the theory of solutions and electrolysis, and the application to the practice of electro-deposition and electrolytic refining of metals. The course also includes lectures on the electric furnace with special consideration of efficiency.

Reference books: Electrometallurgy—Borchers. Principles of Applied Electrochemistry—Allmand and Ellingham. The Electric Furnace—Stansfield. The Electric Furnace—Pring. Physical Chemistry for Colleges—Millard.

115. Electrochemistry. J. T. Burt-Gerrans.

Departments 6e, 7e and 8, IV Year.

A laboratory course accompanying course 114.

Reference book: Practical Physical Chemistry—Findlay.

116*a*. Silicate Chemistry. J. B. Ferguson.

Departments 8a and 9, IV Year; 2 hrs. per week, first term.

The application of phase rule to the chemistry of refractory materials.

ECONOMICS AND BUSINESS ADMINISTRATION

121. Business. R. R. Grant.

Departments 1, 2, 3, 6, 7, 8, 8a and 9, I Year; 1 hr. per week, second term.

A lecture course on the principles underlying accounting and general business methods of a simple nature in order to enable the student to understand and prepare simple financial reports.

122*a*. Technical English. W. J. T. Wright.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 1 hr. per week, both terms.

A lecture course on the expression of ideas and the compilation and writing of engineering reports and letters; technical exposition; the necessity of accurate expression in professional writing; the value of reading.

122*b*. English. W. J. T. Wright.

Department 4, II Year; 1 hr. per week, both terms.

This course of lectures includes a discourse on the literature which refers either directly or indirectly to architecture and the arts. Books are reviewed and discussed in round-table talks.

123. Economics and Finance. C. H. Mitchell.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, II Year; 1 hr. per week, both terms.

An introduction to the study of Economics. The course will deal in an elementary manner with the following:

(1) Scope of Economics.
(2) Economic Geography.
(3) Theory of Value, Supply and Demand.
(4) Theory of Production and Distribution.
(5) Structure of Industry and Social Conditions.
(6) Money, Banking and Finance.
(7) Economics of Canada with special reference to the relation of Engineering to Finance.

Text books: Economics for the General Reader—Clay. Supply and Demand—H. D. Henderson. Annual Financial Reviews.

124. Commercial Law. F. C. Auld.

Departments 4 and 7, III Year; 1 hr. per week, both terms.

General Principles of the Law of Contracts, Principal and Agent, Partnership and Limited Companies with special reference to the Companies Acts. General view of the following:—Negotiable

Instruments, Sale of Goods, Bills of Sale and Chattel Mortgages, Suretyship and Guarantee.

Text book: Falconbridge and Smith—Manual of Canadian Business Law.

125. Engineering Economics. C. R. Young.

Departments 1, 2, 3, 5c, 5s, 7, 8 and 9, IV Year; 1 hr. per week, second term.

A series of lectures on the principles by which the economic practicability of a project is judged and the comparison of competing proposals is made. Consideration is given to first cost and annual cost, methods of estimating, fixed charges and operating expenses, financing of engineering projects, valuation and appraisals. Special attention is given to depreciation and the methods of providing for it. Typical numerical problems are discussed and solved.

Text books: Engineering Economies—Fish. Financial Engineering—Goldman. Principles of Engineering Economy—Grant.

126. Engineering Law. R. E. Laidlaw.

Department 1, IV Year; 1 hr. per week, both terms.

Departments 3, 6, and 7, IV Year; 1 hr. per week, first term.

This course of lectures is designed to co-ordinate engineering practice and law. In the first term attention is directed to the duties and liabilities of the engineer, workmen's compensation, patents and inventions, copyrights, trade marks, industrial designs, promotion of companies, organization of companies, arbitration, expert evidence, engineering contracts, trade unions, combines and industrial disputes. The work of the second term comprises drainage, boundaries and surveys, easements, railways, highways, building trades, factories, office buildings, and public buildings.

Text book: Engineering Law—Laidlaw and Young.

127. Contracts and Specifications. C. R. Young.

Departments 1, 4, and 8, IV Year; 1 hr. per week, second term.

This course of lectures deals with the fundamental principles of contract and specification writing. The critical examination of typical specifications and agreements by the class, forms an essential feature of the instruction.

Text books: Elements of Specification Writing—Kirby. Engineering Law—Laidlaw and Young.

128. Management. C. R. Young.

Department 1, IV Year; 1 hr. per week, first term.

A series of lectures dealing with the fundamental principles upon which management is based. The possibilities of effective management are indicated and its basis is shown to exist in suitable organization, adequate equipment and smooth administration.

Text books: Construction Cost Keeping and Management—Gillette and Dana. Principles of Industrial Organization—Kimball. Principles of Industrial Management—Allcut.

129. Plant Management. G. A. Guess.

Department 8, IV Year; 1 hr. per week, second term.

A course of twelve lectures dealing with some phases of labour, plant organization, smelter contracts and markets.

130. Industrial Management. E. A. Allcut.

Departments 3, 6, 7 and 8a, IV Year; 1 lecture per week, both terms.

This course includes a study of industrial organization, location, arrangement, construction and equipment of industrial plants for efficiency and economy, process routing, scheduling work, reports, methods of superintending, employment, systems of compensating labour and systems of distributing indirect expenses.

Text book: Principles of Industrial Management—Allcut.

131. Municipal Administration. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. per week, second term.

A lecture course dealing with municipal government, assessment and taxation, municipal finance, public utilities, expropriation, annexation problems, town planning, local improvement and other laws relating to municipalities.

133. Public Speaking. F. H. Kirkpatrick.

Department 1, II Year, 1 hr. per week, second term.

Department 4, III Year; 1 hr. per week, first term.

A course on the principles of public speaking and the means of expression, accompanied by practical application and training in actual speaking.

ELECTRICITY

135. Electricity. H. W. Price.

Departments 1, 2, 3, 5, 6, 7, 8, 8a and 9, I Year; 2 hrs. per week, both terms.

A course of lectures on basic principles relating to electric circuits, magnetic circuits, instruments and apparatus in general, distribution of electrical energy, etc., illustrated largely from commercial apparatus. The point of view of this work is quantitative rather than descriptive, for it is believed that men who can solve engineering problems are most likely to grasp underlying principles.

Reference book: Electrical Engineering, Vol. I—Dawes.

136. Electricity (Measurements). J. E. Reid.

Departments 3, 5, 6, 7, 8 and 8a, II Year; 2hrs. per week, both terms.

A course of lectures on the general principles and calculation of electrical circuits, particularly as applied to the measurement of

resistance, current, potential difference, inductance, capacity, power and energy. The principles underlying commercial instruments are considered together with the methods of calibration.

Reference Books: Electrical Measurements—Laws. Electrical Measurements in Theory and Application—Smith. Electrical Measurements and Measuring Instruments—Golding.

136*a*. Electricity (Fundamentals and Networks). J. E. Reid.

Department 7, II Year; 1 hr. per week, both terms.

A study is made of general network theorems and their application to the solution of networks, with problems. Electrostatics, involving fundamental ideas concerning potential and other quantities, and the derivation of basic equations, occupies most of the second term.

137. Electrical Laboratory. V. G. Smith.

Departments 3, 6, 7, 8 and 8a, II Year; 3 hrs. per week, both terms.

Department 5, II Year; 3 hrs. per week, first term.

The more important methods of measurement of resistance, current, potential difference, inductance, and capacity are used, often under conditions such as occur in practice. The principles of measurement are applied to other problems such as the location of line faults and the measurement of temperature rise by resistance changes. Methods of calibrating commercial instruments are also included.

138. Magnetism and Electricity. A. R. Zimmer.

Department 3, III Year; 1 hr. per week, both terms.

Departments 5 and 7, III Year; 2 hrs. per week, first term; 1 hr. per week, second term.

A course of lectures on theory of magnetism and magnetic circuits, theory of direct-current generators, motors, etc.

Reference Books: Electrical Engineering, Vol. I—Dawes. Electrical Circuits and Machinery, Vol. I—Morecroft and Hehre. Electricity and Magnetism for Engineers, Part I—Pender. Principles of D.C. Machines—Langsdorf. Direct-Current Machinery—Pender. Electrical Engineering—Christie. Elements of Electrical Engineering—Cook. D. C. Machinery—Kloeffler, Brenneman and Kerchner.

139. Alternating Current. A. R. Zimmer.

(a) Departments 3, 6, 8 and 8a, III Year; 1 hr. per week, both terms.

(b) Departments 5 and 7, III Year; 1 hr. per week, both terms.

A first course of lectures on alternating current, covering principles of measurement and leading to the analytical and graphical treatment of the simpler problems relative to alternating-current circuits and machinery.

Reference Books: Electricity and Magnetism for Engineers, Part II—Pender. Electrical Engineering—Christie. Electrical Engineering, Vol. II—Dawes. Electrical Circuits and Machinery, Vol. II—Morecroft and Hehre. Alternating Current Electrical Engineering—Maccall. Alternating Current Electrical Engineering—Kemp. Elements of Electrical Engineering—Cook.

140. Electrical Laboratory. A. R. Zimmer, H. W. Price.

Department 3, III Year; 4½ hrs. per week first term, 3 hrs. per week second term.

Departments 5c, 5s, 5g, 5i and 7, III Year; 6 hrs. per week, both terms.

Departments 5h and 5e, III Year; 3 hrs. per week, both terms.

This laboratory course is intended to afford the student an opportunity to become familiar with principles involved in continuous-current shunt, series and compound-wound generators and motors; and, to some extent, alternating-current circuits and machinery. Other sections of the work deal with the magnetic properties of iron and steel, and study of iron losses in transformers and generators.

The course is arranged to stand in close relation to the lecture courses in the subjects of magnetism and electricty and alternating current (courses 138 and 139) for III Year, and to certain design work (course 141).

141. Electrical Design. R. J. Brown.

Departments 5c, 5s, 5i and 7, III Year; 1 hr. per week, both terms.

This course of lectures deals with fundamental principles underlying the design of electrical apparatus and is arranged to prepare the student for Course 142.

142. Electrical Problems and Design Laboratory. R. J. Brown.

Department 7, III Year; 6 hrs. per week, both terms.

In this course the student designs such electrical apparatus as coils, electro-magnets, direct current machines, reactors and transformers. Other allied electrical problems are also solved.

143. Electricity. A. R. Zimmer.

Departments 1, 2, and 9, II Year; 1 hr. per week, both terms.

A course of lectures dealing with fundamental calculations of alternating current circuits and various applications of interest to those who are not making electricity a major subject.

144. Electrical Laboratory. A. R. Zimmer, H. W. Price.

(*a*) Department 1, II Year; 3 hrs. per week, second term; Department 2, IV Year, 3 hrs. per week, first term.

(*b*) Departments 6 and 8a, III Year; 3 hrs. per week, second term

(*c*) Department 8, III Year; 3 hrs. per week, both terms.

These courses are arranged to suit the requirements of the depart-

ments concerned. The experiments are planned with the idea of affording a general knowledge of circuits, power measurements, direct-current and alternating-current machinery and transmission of power.

Reference Books: Elements of Electrical Engineering—Cook.

145*a*. Applied Electricity. V. G. Smith.

Symbolic and Graphical Methods.

Departments 5c and 7, IV Year; 2 hrs. per week, both terms.

Complex quantities and their use in a.c. problems. Loci for current and voltage vectors for given limitations on circuit constants. Short line distribution circuit loci; approximate graphical theory of synchronous motor.

Reference Books: Principles of Alternating Currents—Lawrence. Alternating Current Circuits—Weinbach.

145*b*. Applied Electricity. V. G. Smith.

Wave Form and Transmission Line.

Departments 5c and 7, IV Year; 1 hr. per week, both terms.

Non-sinusoidal alternating current waves, analysis of waves, forms of symmetry, three phase limitations, elimination of undesired harmonics, heating of rotary converters; power, current, and voltage readings as influenced by wave form.

145*c*. Applied Electricity. H. W. Price.

Alternating Current Machinery and Measurements.

Department 7, IV Year; 2 hrs. per week, both terms.

Polyphase alternating-current measurements of power, reactive power, apparent power, finding the indications of meters from given wiring diagrams, constructing wiring diagrams to obtain required meter indications. Potential and current transformers. Meter indications with distorted wave forms. Power transformers. Properties of alternators; induction motors of squirrel cage and wound-rotor types; synchronous motors; regulators; current-limiting reactors; arresters; and other general apparatus.

146. Electrical Laboratory. A. R. Zimmer, H. W. Price.

Department 5c, IV Year; 6 hrs. per week, both terms; Department 7, IV Year; 19 hrs. per week, both terms; in connection with Course 145.

This laboratory course involves a thorough study of principles and properties of single-phase and polyphase circuits and apparatus. Both vector and analytical methods are applied to the solution of problems based on tests made on laboratory machines.

The work deals mainly with constant-voltage and constant-current transformers, single and polyphase alternators, synchronous motors, rotary converters, induction and single-phase commutating motors, transmission line, etc. The work does not consist only of factory

tests, but is designed to lead the student to apply theory to practice as illustrated in the apparatus under test, with a view to an exact understanding of methods and an appreciation of limitations under many conditions. Free use is made of the oscillograph as a necessary device for "seeing" conditions under investigation. The best commercial measuring instruments are available.

Reference Books: Electrical Engineering—Christie. Experimental Electrical Engineering, Vols. I and II—Karapetoff. Principles of A.C. Machinery—Lawrence. A.C. Machinery—Bryant and Johnson.

147. Thermionic Tubes. B. deF. Bayly.

Departments 5c, 5s, 5i, and 7c, IV Year; 2 hrs. per week, first term.

Vacuum Tubes and their application, including circuits for amplification, modulation, detection, etc.

Reference books: Communication Engineering—Everitt. Fundamentals of Vacuum Tubes—Eastman. Fundamentals of Engineering Electronics—Dow.

148. Thermionic Tube Laboratory. B. deF. Bayly.

Department 5c, 5s, and 5i, IV Year; 6 hrs. per week, first term.

Department 7c, IV Year; 9 hrs. per week, first term.

This course is taken in connection with course 147. The work in the laboratory covers experiments necessary to verify the theories and show methods of measurement used in connection with thermionic tubes.

149. Acoustics. B. de F. Bayly.

Departments 5c, 5s and 7c, IV Year; 1 hr. per week, first term.

The principles of recording, transmission, and reproduction of sound in connection with electrical systems. Mechanical vibrating systems; microphones; loud speakers; causes of distortion; principles of hearing; reverberation.

Reference Books: Elements of Engineering Acoustics—Hughes. A Text Book of Sound—Wood. Acoustics—Stewart and Lindsay.

150. Communication Networks. B. deF. Bayly.

Departments 5c, 5s, and 7c, IV Year; 2 hrs. per week, second term.

This course covers the fundamental networks used in electrical communication, such as filters, bridges, impedance matching networks, etc.

Reference books: Communication Engineering—Everitt. Communication Networks, Vols. I and II—Guillemin. Alternating Current Bridge Methods—Hague. High Frequency Measurements —Hund.

151. Communication Laboratory, B. deF. Bayly.

Departments 5c and 5s, IV Year; 6 hrs. per week, second term.

Department 7c, IV Year, 9 hrs. per week, second term.

This laboratory work concerns principles of measurement and demonstration of principles described in course 150.

152. Operational Calculus. V. G. Smith.

Departments 5c, 5s, 5e and 5i, IV Year; 2 hrs. per week, both terms.

Operational methods before Heaviside. Operators of electric circuits. Series expansions. Useful rules concerning shifting and transfer operations, differentiation and integration with respect to parameters. The Heaviside Expansion Theorem. Duhamel's theorem and Carson's integral. Campbell and Foster's mates and other tables. Evaluation by contour integration. Borel's theorem.

Reference books: Electromagnetic Theory—Heaviside. Operational Circuit Analysis—Bush. Electric Circuit Theory and the Operational Calculus—Carson. Heaviside's Operational Calculus—Berg. Fourier Integrals for Practical Applications—Campbell and Foster.

153. Electromagnetic Theory. V. G. Smith.

Departments 5c, 5s, and 5g, IV Year; 2 hrs. per week, both terms.

The principles of electromagnetism. Magnetic fields from currents in the neighbourhood of feromagnetic bodies. Electromagnetic waves guided by wires, their attenuation and reflection. Skin effects. Plane waves in space, their reflection and refraction. Cylindrical and spherical waves. Radiation from antennas.

Reference books: Electromagnetic Theory—Heaviside. Electricity and Magnetism—Jeans. Electro-Magnetic Problems in Electrical Engineering—Hague. Classical Electricity and Magnetism—Abraham-Bocker.

154. Mathematical Applications in Electrical Engineering. V. G. Smith.

Department 7, III Year; 1 hr. per week, both terms.

These lectures are intended to co-ordinate certain branches of mathematics, such as complex numbers, simple determinants and elementary differential equations, with their applications to the problems of electrical engineering.

DESCRIPTIVE GEOMETRY, ENGINEERING PROBLEMS AND DRAWING

DESCRIPTIVE GEOMETRY

160. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3, 5, 6, 7, 8, 8a and 9, I Year; 1 hr. per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solutions of problems relating to straight lines and planes.

161. Descriptive Geometry. J. R. Cockburn.

Department 4, I Year; 1 hr. per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solution of problems relating to straight lines and planes, special reference being made to the determination of shades and shadows.

162. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3, 5, 7, and 9, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of the work taken in the First Year with the following additions: problems relating to curved surfaces, principles of shades, shadows and perspective.

163. Descriptive Geometry. J. R. Cockburn.

Department 4, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of the work taken in the First Year with the addition of problems relating to curved surfaces, shades, shadows and perspective.

164. Descriptive Geometry. J. R. Cockburn.

Department 1, III Year; 1 hr. per week, first term.

This course of lectures deals with spherical projections, the principles of mapmaking, and the graphical solution of spherical triangles.

ENGINEERING PROBLEMS AND DRAWING

These courses consist primarily in the solving of problems by the student at his drafting table under the personal guidance of an instructor. The problems are intended to supplement certain lecture courses. The problems in the First and Second years deal with the fundamental engineering studies—Mathematics, Applied Mechanics, Descriptive Geometry, the plotting of surveys that have been made by the students in the field, Theory of Mechanism and Steam Engines, while in the Third and Fourth Years, the problems deal mainly with design. During the hours devoted to mathematical problems, members of the staff in mathematics are present to assist.

166*a*. Engineering Problems and Drawing. A. Wardell.

Department 1, I Year; 10 hrs. per week, first term; 17 hrs. per week, second term.

Drawing and lettering. Plotting of original surveys. Problems in Descriptive Geometry. Graphical and analytical solutions of problems in Applied Mechanics. Problems in Mathematics (Analytical Geometry and Calculus).

166*b*. Engineering Problems and Drawing. A. Wardell.

Departments 2 and 9, I Year; 9 hrs. per week, first term; 12 hrs. per week, second term.

A course similar to 166a.

166*c*. Engineering Problems and Drawing. A. Wardell.

Department 3, I Year; 9 hrs. per week, first term; 15 hrs. per week, second term.

A course similar to 166a.

166*d*. Engineering Problems and Drawing. A. Wardell.

Department 4, I Year; 4 hrs. per week; both terms.

An elementary course in drawing and lettering. The solving of a few problems in Descriptive Geometry, Applied Mechanics and Mathematics.

166*e*. Engineering Problems and Drawing. A. Wardell.

Department 5, I Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

Drawing and lettering. Problems in Descriptive Geometry. Graphical and analytical solutions of problems in Applied Mechanics. Problems in Mathematics (Analytical Geometry and Calculus).

166*f*. Engineering Problems and Drawing. A. Wardell.

Department 6, I Year; 3 hrs. per week; both terms.

An elementary course in drawing and lettering. The solving of a few problems in Descriptive Geometry, Applied Mechanics and Mathematics.

166*g*. Engineering Problems and Drawing. A. Wardell.

Department 7, I Year; 9 hrs. per week, first term, 12 hrs. per week, second term.

A course similar to 166a, but containing more mathematical problems.

166*h*. Engineering Problems and Drawing. A. Wardell.

Department 8, I Year; 13 hrs. per week, first term; 19 hrs. per week, second term.

A course similar to 166a.

166*ha*. Engineering Problems and Drawing. A. Wardell.

Department 8a, I Year; 3 hrs. per week, both terms.

A course similar to 166f.

167*a*. Engineering Problems and Drawing. J. J. Spence.

Department 1, II Year; 5 hrs. per week, first term; 10 hrs. per week, second term.

Problems in Descriptive Geometry—intersection of curved surfaces. Plotting of original surveys. Problems in Mechanics of Materials—properties of sections, designs of simple members. Problems in Mathematics (Calculus).

167*b*. Engineering Problems and Drawing. J. J. Spence.
Departments 2 and 9, II Year; 3 hrs. per week, first term; 10 hrs. per week, second term.
Problems in Descriptive Geometry, Mechanics of Materials, Flow sheets.

167*c*. Engineering Problems and Drawing. J. J. Spence.
Department 3, II Year; 15 hrs. per week, first term; 8 hrs. per week, second term.
Problems in Descriptive Geometry—intersection of curved surfaces. Problems in Mechanics of Materials, Theory of Mechanism, Steam Engines, Electricity. Problems in Mathematics (Calculus).

167*f*. Engineering Problems and Drawing. J. J. Spence.
Department 6, II Year; 7 hrs. per week, first term; 3 hrs. per week, second term.
Problems in Mechanics of Materials, Electricity and Mathematics.

167*g*. Engineering Problems and Drawing. J. J. Spence.
Department 7, II Year; 6 hrs. per week, first term; 9 hrs. per week, second term.
A course similar to 167c, but with more problems in Mathematics.

167*h*. Engineering Problems and Drawing. J. J. Spence.
Department 8, II Year; 3 hrs. per week, first term; 6 hrs. per week, second term.
Problems in Mechanics of Materials, Electricity, and Descriptive Geometry.

167*ha*. Engineering Problems and Drawing. J. J. Spence.
Department 8a, II Year; 7 hrs. per week, first term; 3 hrs. per week, second term.
A course similar to 167f.

168*a*. Engineering Problems and Drawing. W. B. Dunbar.
Department 1, III Year; 13 hrs. per week, first term; 14 hrs. per week, second term.
Problems in design of steel structures, riveted and welded connections, tension members, beams, columns, highway and railway trusses. Problems in Descriptive Geometry to illustrate the theory of map making.

168*b*. Engineering Problems and Drawing. W. B. Dunbar.
Department 2, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.
Problems in design of steel structures, riveted and welded connections, tension members, beams, columns.

168*c*. Engineering Problems and Drawing. W. B. Dunbar.
Department 3, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.
A course similar to 166b.

168*ee*. Engineering Problems and Drawing. W. B. Dunbar.
Department 5e, III Year; 6 hrs. per week, first term; 9 hrs. per week, second term.
A course similar to 166b.

168*eh*. Engineering Problems and Drawing. W. B. Dunbar.
Department 5h, III Year; 3 hrs. per week; both terms.
A course similar to 168b, but less extensive.

168*f*. Engineering Problems and Drawing. W. B. Dunbar.
Department 6, III Year; 3 hrs. per week; both terms.
A course similar to 168b, but less extensive.

168*h*. Engineering Problems and Drawing. W. B. Dunbar.
Department 8, III Year; 3 hrs. per week; first term.
Plotting of flow sheets.

168*ha*. Engineering Problems and Drawing. W. B. Dunbar.
Department 8a, III Year; 3 hrs. per week; both terms.
A course similar to 168f.

178*a*. Engineering Problems and Drawing. W. J. Smither.
Departments $1a_1$, $1a_2$, $1a_3$, IV Year; 15 hrs. per week average; both terms.
A course dealing with advanced problems on the design of steel and reinforced concrete structures—floor panels, mill buildings, tanks, reservoirs, towers, truss and arch bridges, foundations, dams, retaining walls, wind bracing. Problems on moment distribution in rigid frames, influence lines and deflection of trusses.

178*a2*. Engineering Problems and Drawing. W. J. Smither.
Department $1a_2$, IV Year.
A course dealing with problems in the design of railway structures 269a.

178*c*. Engineering Problems and Drawing. W. J. Smither.
Department 3, IV Year; 3 hrs. per week, first term.
A course dealing with problems on the determination of stresses in and the design of mill buildings, flume trestles, crane runways, and floor panels for machinery loading.

178*ha*. Plant Design. W. J. Smither, R. J. Montgomery.
Department 8a, IV Year; 3 hrs. per week, first term.
A course devoted to the original design of ceramic plants, driers, kilns, etc.

179. Engineering Problems and Drawing. W. J. Smither.
Department $1a_1$, IV Year; 3 hrs. per week, second term.
Problems on the design of water distribution and sewer systems as well as water and sewage treatment works. (Course 267a).

APPLIED PHYSICS

185*a*. Applied Physics. W. J. Jackson.

Departments 3 and 7, I Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the production and distribution of light, photometry and illumination, optics and optical instruments.

185*b*. Optics. K. B. Jackson.

Department 6, I Year; 1 hr. lecture per week, both terms, 3 hrs. laboratory per week, first term.

A course of lectures with laboratory work on light, geometrical and physical optics, and optical instruments.

Optics, see Course 312.

186. Applied Physics Laboratory. L. E. Jones.

Department 6, II Year; 1 hr. laboratory per week, second term.

A short laboratory course supplementing 185b in Optics.

187. Applied Physics. K. B. Jackson.

Department 1, I Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

A course of lectures and laboratory work on optics and optical instruments, the projection of light and its applications in marine and railway signalling, flood lighting, etc.

188. Photography. L. E. Jones.

Department 4, II Year; 1 hr. lecture, 3 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the principles of photography, photographic equipment, materials, and processes, with special reference to architectural photography and an outline of the photo-mechanical processes.

188*a*. Photography Applied to Research. K. B. Jackson, D. H. Hamly.

Senior and graduate students; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the principles of photography, the choice and use of equipment for special purposes, the photometry of projection, sensitometry and the correct use of photographic materials and processes.

189. Photographic Surveying. K. B. Jackson, W. M. Treadgold.

Department $1a_3$, IV Year; 3 hrs. lectures per week, first term; 2 hrs. lectures per week, second term; 3 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on the photographic processes involved, the calibration of surveying cameras, the stereoscopic examination of photographs, and methods of plotting in ground and aerial photographic surveying.

189*a*. Photographic Surveying. K. B. Jackson, W. M. Treadgold.

Department 1b, IV Year; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

A short course of lectures with laboratory work on the subject matter of course 189.

190. Light and Acoustics. V. L. Henderson.

Department 4, III Year; 1 hr. lecture, 2 hrs. laboratory per week, both terms.

A course of lectures and laboratory work on the production and propagation of sound, the control of reverberation, sound transmission through partitions, and vibration insulation; and an elementary course in the production of light, and the measurement of light and electricity, in preparation for course 191.

191. Illumination Design. V. L. Henderson.

Department 4, IV Year; 1 hr. lecture, 1 hr. laboratory per week, both terms.

A course of lectures with laboratory work on the control of light distribution, the computation of illumination and brightness, and the design of lighting installations for public and private buildings.

By co-operation with the staff of the School of Architecture, problems in lighting design and acoustics will form a part of certain problems in architectural design in courses 31b, 31c, and 31d.

191*a*. Architectural Acoustics. K. B. Jackson, V. L. Henderson.

Department 5i, IV Year; 1 hr. lecture, 3 hrs. laboratory per week, first term; 3 hrs. lectures, 9 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the design of buildings for good acoustics, on the calculation and measurement of the acoustical properties of buildings and materials, and on the treatment of buildings to improve their acoustical properties and to control the nuisance of noise.

192. Photometry. K. B. Jackson, V. L. Henderson.

Department 7i, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, first term; 1 hr. lecture, 3 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the production, distribution, and measurement of light and colour, the theory and application of visual and physical photometers, and the photometry of projection equipment.

192*a*. Illumination Design. K. B. Jackson, V. L. Henderson.

Department 7i, IV Year; 1 hr. lecture, 6 hrs. laboratory per week, second term.

A course of lectures with laboratory work on the theory and design of lighting equipment and installations.

192*b*. Photometry and Illumination Design. K. B. Jackson, V. L. Henderson.

Department 5i, IV Year; 2 hrs. lecture, 6 hrs. laboratory per week, both terms.

A course of lectures with laboratory work on measurements of luminous intensity, luminous flux, illumination, brightness, reflection, transmission, absorption, diffusion, and colour by visual and physical methods; and on the design and application of illuminating engineering equipment.

GEOLOGY

193. Field Work. E. S. Moore.

Departments 2 and 9, III Year; one week at the University Survey Camp preceding the opening of the first term.

194. Pleistocene Geology and Physiography. A. MacLean.

Departments 2 and 9, IV Year; 1 hr. per week, both terms.

Pleistocene Geology. Lectures on the formation and distribution of the drift deposits of North America, with brief references to other regions. Glacial, interglacial, and postglacial beds are described, changes of climate are discussed with their probable causes, and the economic features of the clays, sands, and gravels are considered.

Physiography. A course of lectures on the surface forms of the earth, and on the geological factors that have produced them. The broad features of the earth, its plains, tablelands, hills, valleys, mountains, oceans, rivers, and lakes are discussed in a general way; methods of topographical surveying and mapping are referred to, and the chief physiographic areas of Canada are described.

Works of reference: Ice Ages, Recent and Ancient—Coleman. Physiography—Salisbury.

195. Elementary Geology. J. Satterly.

Department 1, II Year; Department 5g, III Year; 2 hrs. per week, second term.

A course in general geology with special reference to Canadian formations.

Works of reference: Introduction to Geology—Scott. Elementary Geology—Coleman and Parks.

195*a*. Historical Geology. V. J. Okulitch.

Department 9, III Year; 5 hrs. per week, both terms.

Principles of sedimentation, divisions of the geological column, identification of fossils and their use in determining the age of rocks.

Text book: Historical Geology—Schuchert and Dunbar.

196. Geology and Ore Deposits. J. Satterly.

Departments 8 and 8a, II Year; 2 hrs. per week, both terms.

Lectures and laboratory work on historical, structural, and economic geology, designed to familiarize the student with the more important principles, facts, and terms of general geology.

Works of reference: As in course 195.

197. Engineering Geology. A. MacLean.

Department 1, III Year; 1 hr. per week, both terms.

This course deals with the application to engineering of dynamic, structural, and economic geology.

Works of reference: Engineering Geology—Ries and Watson.

198. General Geology. G. B. Langford.

Departments 2 and 9, II Year; 2 hrs. per week, first term; 3 hrs. per week, second term.

Lectures on geological principles, designed to introduce students to the study of geology.

Text book: Geology—Emmons, Thiel, Stauffer and Allison.

198*a*. Structural Geology. G. B. Langford.

Department 9, III Year; 5 hrs. per week, first term; 3 hrs. per week, second term.

A study of the structures caused by the deformation of the earth, and a laboratory course to illustrate the principles covered in the lectures.

Text books: Geologic Structures—Willis. Structural Geology—Nevin.

199. Precambrian Geology. E. S. Moore.

Departments 2, 5g and 9, IV Year; 2 hrs. per week, first term.

Lectures on the Precambrian formations of Canada—their rocks, distribution, relationships, and economic features. Briefer accounts are given of similar formations in the United States and elsewhere.

Works of reference: Reports of the Geological Survey of Canada and of the Ontario Department of Mines. Reports of the United States Geological Survey.

199*a*. Mining Geology. G. B. Langford.

Department 9, IV Year; 5 hrs. per week, both terms.

Detailed study of the geology of Canadian and foreign mining camps.

199*b*. Field Methods. G. B. Langford.

Department 9, IV Year; 3 hrs. per week, both terms.

A course covering the principles of geological surveying and mapmaking, the making of mine models and block diagrams, and the graphic representation of complex geological structures.

200. Mining Geology. E. S. Moore.

Departments 2 and 5g, IV Year; 2 hrs. per week, second term.

A course of lectures on geological problems associated with mining, typical mining regions in Canada, the United States, and elsewhere being discussed from the geological side.

Works of reference: Mineral Industry. Geology Applied to Mining—Spurr; and the works mentioned under course 199.

201. Geological Excursions. A. MacLean.

Departments 2 and 9, IV Year.

During October weekly trips will be made to points of interest near Toronto.

202. Economic Geology. E. S. Moore.

Departments 2 and 9, III Year; Department 5g, IV Year.

(*a*) Ore Deposits: 1 hr. per week, both terms.

Discussion of the origin and classification of ore deposits, the mode of occurrence of the chief ores, and statistics of production. Special attention is given to the metals mined in Canada.

(*b*) Economic Geology of the Non-metals: 2 hrs. per week, second term.

Lectures on the origin and mode of occurrence of the valuable non-metallic substances—coal, oil, building stone, gypsum, cement materials, etc.

Works of reference: Economic Geology—Ries. General Economic Geology—Emmons. Coal—Moore. Practical Oil Geology—Hager. Mineral Resources of Canada—Moore. Introduction to the Study of Ore Deposits—Hatch.

203. Economic Geology. G. B. Langford.

Department 2, III Year; 2 hrs. per week, second term.

Laboratory work on ores, manner of occurrence, vein structure, etc., also the examination and construction of geological maps and sections of typical mining regions.

203*a*. Economic Geology. G. B. Langford.

Department 9, III Year; Department 5g, IV Year; 3 hrs. per week, both terms.

Laboratory work on ores, geological features of mining areas, interpretation of drill logs, geological maps, and structure sections.

203*b*. Location of Mineral Deposits. E. S. Moore.

Department 5g, IV Year; 2 hrs. per week, second term.

Geological features and principles involved in the application of geophysical methods in the search for mineral deposits, and the interpretation of the structure of the earth's crust.

203*c*. Economic Geology. J. Satterly.

Department 8a, IV Year; 2 hrs. per week, second term.

The nature, occurrence and origin of non-metallic deposits, excepting fuels.

203*d*. Geology of Canada. A. MacLean.

Department 9, IV Year; 2 hrs. per week, first term, 5 hrs. per week, second term.

A survey of the physiography, historical geology, major structural features and mineral deposits of the country.

204. Building Stones. E. S. Moore.

Department 4, IV Year; 1 hr. per week, first term.

Lectures and laboratory work on decorative and structural stones used in building; their properties, sources, extraction, and preparation for use in buildings.

204*a*. Thesis.

Department 9, IV Year; 6 hrs. per week, both terms.

The thesis will consist of a report on an investigation made by the student. It is intended to test his ability to make an independent field or laboratory study of some geological problem. The problem chosen must be approved by the head of the Department of Geology and plans for the thesis completed not later than November 1 of the student's Fourth Year.

HYDROSTATICS AND HYDRAULICS

205. Hydraulics. R. W. Angus.

Departments 1, 2, 3, 6 and 7, III Year and Department 8a, IV Year; 2 hrs. per week, both terms.

This is a course of lectures in hydraulics devoted to the development and discussion of formulae relating to the flow of water in pipes, the measurement of discharge by various methods, such as orifices and weirs, the conditions of flow obtaining in open channels, artificial and natural, and in pipes flowing partially full, together with other kindred subjects.

The object of this course is to provide the student with a good working knowledge of the fundamental principles of hydraulics, such as are useful in practical work, and are necessary to the intelligent investigation of more advanced problems, such as the design of water supply, sewerage and irrigation systems, and water power plants.

Text book: Hydraulics for Engineers—Angus.

206. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Departments 1, 2, 3 and 7, III Year; one 3 hr. period per week, second term.

Department 6, III Year and Department 8a, IV Year; average 1½ hrs. per week, second term.

The work in this course is intended to illustrate the lecture course given in hydraulics and to give the student some working acquaintance with the formulae derived. Experiments are made to deter-

mine the coefficients for orifices of the various types used in practice and for weirs. The results of these experiments are used in measuring the discharge in subsequent experiments on meters and for the determination of hydraulic resistances in various cases of flow in pipes. The complete course illustrates very fully the application of the course of lectures to actual cases.

207. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 1 lecture per week, both terms.

A course of lectures dealing with the various problems of unsteady flow such as occur in power plants, penstocks, etc. Much of the work is done by the process of arithmetic integration, and the lecture work is supplemented by problems solved by the students in the work rooms, the time for which is included in course 209. Surges, water hammer, stream flow data, etc., are discussed.

The problems of collection of water for power purposes, use of the mass curve, rainfall and evaporation, turbine governing, etc., are also treated as far as possible.

Text book: Hydraulics for Engineers—Angus.

208. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 2 lectures per week, both terms.

The most important question considered and to which most of the lectures are devoted is the theory of turbines and centrifugal pumps, the effect of the design on the speed, discharge and efficiency being fully taken up. The course includes the selection of turbines and pumps for given service; intakes, draft tubes and all matters connected with hydraulic power plants.

Text book: Hydraulics for Engineers—Angus.

209. Hydraulics. R. W. Angus, R. Taylor.

Department 7h, IV Year; 9 hrs. per week, first term, 6 hrs. per week, second term; Department 3, average of 7½ hrs. per week in 3 and 2 hr. periods.

A laboratory course devoted to experimental work on turbines of various types and centrifugal and turbine pumps and other similar devices. This experimental work is arranged to illustrate the lectures on turbine and pump design. The experiments are made on hydraulic models and on two large turbine pumps used in the laboratory supply, as well as on apparatus specially designed for instruction. Various methods of measuring water-power and the efficiency of machines are also given. A list of the equipment now available and which is used in this course, is given in Section XII.

210. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Department 8, IV Year; 3 hrs. per week, second term.

A laboratory course of experiments on orifices, weirs, meters, etc. See course 206.

211. Hydraulics. R. W. Angus, R. Taylor.

Department 1a, IV Year; 1 hr. lecture per week, both terms.

Laboratory course of 1 three hr. period per week, first term.

The course of lectures deals with general hydraulic problems such as surges in pipe lines, water hammer, flow in open channels and backwater, mass curves, a general discussion of pumps and turbines.

The laboratory course consists of class room instruction and experiments bearing on the lectures.

Text book: Hydraulics for Engineers—Angus.

212. Hydrostatics. R. W. Angus.

Departments 3, 6, 7 and 8a, II Year; 1 hr. per week, second term.

Fluid pressure and its application in the design of engineering structures. Forces acting on the bottoms and ends of tanks; pressures on pipes, gates and walls; stability of dams; laws governing the equilibrium of floating bodies.

Text book: Hydraulics for Engineers—Angus.

213. Properties of Fluids. G. R. Lord.

Department 3, I Year; 1 hr. per week, both terms.

This course of lectures is intended to prepare the student for work in hydraulics, thermodynamics and machine design.

214. Properties of Fluids. G. R. Lord.

Department 3, II Year; 1 hr. per week, both terms.

This lecture course is a continuation of Course 213.

THERMODYNAMICS AND HEAT ENGINES

216. Steam and Heat Engines. E. A. Allcut.

Departments 3 and 7, II Year; 1 lecture per week, both terms.

Departments 2, 8 and 9, II Year; 1 lecture per week, first term.

A course of lectures dealing with the history and development of the steam engine with special reference to the theory and design of valves and valve operating mechanisms. The principles of heat engines and the various forms of heat engine are also discussed briefly.

217. Thermodynamics. E. A. Allcut.

Departments 3, 6, 7 and 8a, III Year; 2 lectures per week, both terms.

In this lecture course the laws of heat are used to develop the characteristic equation for a perfect gas and the use of thermal lines on the pressure-volume diagram. The properties of Carnot's cycle are then considered, followed by application of these principles to the hot-air engine, internal combustion engine and air compressor. A consideration of the properties of vapours and their application to the steam engine cycle and refrigeration concludes the course.

218. Heat Engines. R. C. Wiren.

(*a*) Departments 3 and 8, III Year; 1 lecture per week, both terms.

This course of lectures is intended to supplement the general lecture course in Thermodynamics by showing the practical application of the laws discussed therein. The laws of combustion, their application to the boiler practice and the generation and uses of steam are the principal points considered.

(*b*) Department 3, III Year; 1 lecture per week, both terms.

These lectures are a further development of the internal combustion work commenced in the Second Year, the influence of thermodynamic considerations on the design of heat engines, and problems in heat transfer, being discussed. The laws of heat transmission and their influence on Heating and Ventilation problems are also considered.

219. Thermodynamics and Mechanical Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, III Year; 1 three hr. period per week, both terms.

Department 7, III Year; 3 hrs. per week, first term.

Time to be in three-hr. periods in all cases.

This laboratory course is designed to assist in a clearer understanding of thermodynamics, machine design and mechanics of machinery. The work in thermodynamics consists in the setting of slide valves, indicating engines measuring the brake horse-power, simple engine and boiler tests and the testing of gas and gasoline engines under various conditions. The mechanical laboratory work deals with the efficiency of belts as well as of several machines of simple construction. An examination of lubricating oils is also made by means of well-known methods. Experiments are also made on the balancing of reciprocating and rotating masses.

220. Thermodynamics. E. A. Allcut.

Departments 3 and 7t, IV Year; 2 hrs. per week, both terms.

This is a continuation of course 217, the general thermodynamic theory being studied from the conception of the thermodynamic surface. The theory of the flow of gases and vapours through orifices, nozzles and pipes is then discussed, and its application to the various forms of turbine is outlined. Thermodynamic losses and their causes, as exemplified by the steam power plant, are studied in detail.

221. Heat Engines. E. A. Allcut.

Departments 3 and 7t, IV Year; 1 hr. per week, both terms.

The first part of the course deals with refrigeration and includes studies on reversed heat engines, as exemplified by air, vapour compression and absorption machines. The various cycles em-

ployed and the properties of refrigerating vapours are studied in detail. Applications of refrigeration, as in air conditioning and industrial processes, are also described.

The second part is devoted to internal combustion and begins with a discussion of the constant volume and constant pressure cycles together with their associated losses. The properties of the various liquid fuels and their influence on combustion in a cylinder are also studied. The course concludes with a consideration of high speed compression ignition engines and the problems associated therewith.

222. Thermodynamics. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, IV Year; average 7½ hrs. per week, and 7t, IV Year, 9 hrs. per week, first term, 6 hrs. per week, second term.

The work in this year is a continuation and extension of the work covered in the Third Year laboratory course. Careful tests are made of heaters and of engines of various types, such as simple, tandem and cross-compound steam engines; steam turbine; refrigerating machine; injectors and steam pumps, etc.; and an application is made of Hirn's analysis and the entropy diagram to the results obtained. A complete set of experiments is made on each machine and the result plotted so as to show clearly to the student the effect of various alterations in the adjustment of the engine on the resulting efficiency.

Several modern gas and gasoline engines give ample opportunity for the study of this type of engine, and facilities are provided for sampling the gas supply and exhaust.

Two experimental stacks and three boilers enable results to be obtained on boiler efficiency and chimney draft.

223. Thermodynamics. E. A. Allcut.

Departments 1 and 8, III Year; 1 lecture per week, both terms.

Department 2, IV Year; 1 lecture per week, both terms.

The general principles of thermodynamics, the properties of a perfect gas and their application to the Carnot cycle are first studied. This is followed by a consideration of the air compressor cycle, some details of air compressor operation and the theory of the flow of air through pipes and orifices. The properties of vapours and the principles of steam engine operation are also discussed.

224. Thermodynamics Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 1, III Year; eight 3 hr. periods, second term.

Departments 6 and 8a, III Year; average 1½ hours per week, second term.

Department 8, III Year; 3 hrs. per week, second term.

Department 2, IV Year; 3 hrs. per week, first term.

A course of experiments with steam and gas engines, compressed air, etc.

225. Thermodynamics. E. A. Allcut, R. C. Wiren.

Department 5h, III Year; 2 hrs. lecture per week, both terms, and 3 hrs. per week in the laboratory, second term.

The lecture course consists of a study of thermodynamic cycles and their application to engines, compressors, turbines and refrigerating machines. The properties and the limitations of the various working fluids are also considered in relation to their use in such machines.

The laboratory work comprises a series of experiments designed to show how the principles given in the lecture courses are applied in practice.

226. Aircraft Engines. E. A. Allcut.

Department 5h, IV Year; 1 hr. per week, both terms.

The lectures in the first term will consist partly of descriptions of the various types of aircraft engines and will include a consideration of the laws of heat transfer and their application to cooling problems in aircraft engine cylinders. Those in the second term will be identical with Course 221 and will be taken in conjunction with IV Year, Departments 3 and 7t.

MACHINERY

227*a*. Shop Work. W. G. McIntosh.

Department 3, III Year; 600 hrs.

The student is required to obtain this practical experience in industry, and preferably in the foundry, the forge shop and the machine shop. Such work assists the student in his understanding of the lecture and laboratory work throughout his entire course in Mechanical Engineering, and particularly the design work in his Third and Fourth Years.

Instruction regarding the type of work which is acceptable, and any special requirements, will be given to the student during his Second Year.

227*b*. Shop work. W. G. McIntosh.

Department 3, IV Year; the balance of 1200 hours.

This is a continuation of the work outlined in the Third Year course 227a.

Instruction regarding the type of work which is acceptable, and any special requirements, will be given to the student during his Third Year.

228. Machines and Processes. W. G. McIntosh.

Department 3, I Year; 1 hr. per week, both terms.

In this lecture course the various machines and processes used in shops are treated in a simple manner, so as to acquaint the student with the nature of such work. The course is largely descriptive.

Text books: Factory Equipment—Roe and Lytle. Metal Castings—Campbell.

228*a*. Machines and Processes. W. G. McIntosh.

Department 3, II Year; 1 hr. per week, both terms.

This course of lectures is a continuation of Course 228 in the First Year, but dealing more particularly with materials of design and production methods. In addition, standards, tolerances, limits, fits and mechanical drafting room practice will be explained.

Text books: Factory Equipment—Roe and Lytle. Machine Drawing—Tozer and Rising. Drawings and Drafting Room Practice.

229. Machinery. W. G. McIntosh, G. H. Hally.

Department 1, III Year; 1 lecture per week, both terms, and 1 three hour drafting board period per week, second term.

This course of lectures and work on the drafting board is intended to give the civil engineer some acquaintance with the machinery used in bridges, machinery for conveying and moving materials, shovels, pumping, etc. The drafting problems will be used to illustrate the lecture course.

Text book: Machine Design—Berard and Waters.

230. Theory of Mechanism. R. Taylor.

Departments 3 and 7, II Year; 2 hrs. lectures per week, both terms.

This course of lectures treats of the elementary construction of machines and of the motions of the various parts. Methods of determining linear and angular velocities, methods for the solution of elementary problems involving forces and methods for the determination of the mechanical efficiency of machines are discussed. Velocity diagrams, crank effort and torque diagrams are plotted. Cams, toothed gearing and various types and applications of trains of gearing are considered.

Text book: Theory of Machines—Angus.

231. Mechanics of Machinery. W. G. McIntosh.

Departments 3 and 7, III Year; 1 hr. per week, both terms.

This course is devoted to a consideration of accelerations in machines, acceleration and inertia forces and effects, balancing of machines, kinetic energy of machines, speed fluctuations, proper weight of fly-wheel.

Applications of the methods described are made to various machines, including engines, machine tools, link motions, etc., and the lecture work is followed up by the solution of numerous examples in the drafting room.

The methods of analysis employed are those developed in course 230.

Text book: Theory of Machines—Angus.

232. Elementary Machine Design. W. G. McIntosh.

Departments 6, 7 and 8a, II Year; 1 hr. per week, both terms.

This is a preparatory course intended to familiarize the student with the different shop methods and processes, casting, forging, machining, etc., used in the production of machine parts, to enable him to make proper provision in the design of such parts to facilitate their production.

In addition, the various standards, machine and pipe threads, tapers, pipe fittings, etc., are described and mechanical drafting room practice explained. Tolerances, limits, fits and gauges are discussed.

Text book: Factory Equipment—Roe and Lytle. Drawings and Drafting Room Practice.

233. Machine Design. W. G. McIntosh, G. H. Hally.

Departments 3 and 7, III Year; 2 lectures per week, both terms.

The design work averages 8 hrs. per week for Department 3, and 3 hrs. per week for Department 7, the periods to be of not less than 2 hrs. duration.

The lectures in this course deal with the design of various machine elements, including screw threads for fastening and power transmission, shafting, bearings (journal, thrust, ball and roller), belts, pulleys, spur gears, fly-wheels, keys, clutches, springs, etc.

The problems worked out in the drafting room are planned to include the design of all of the above and with a view to developing the student's judgment and sense of proportion in design.

Text book: Design of Machine Elements—Faires.

234. Machine Design—W. G. McIntosh, G. H. Hally.

Departments 2, 6, 8 and 8*a*, IV Year; 1 lecture per week, both terms.

The design work occupies 3 hrs. per week for the second term only.

The lectures in this course deal with the design of various machine elements, particularly those likely to be met with in chemical and metallurgical plants, and in mining work.

The problems worked out in the drafting room are designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical and metallurgical apparatus, and mine machinery.

Text book: Machine Design—Berard and Waters.

234*a*. Elementary Machine Design. W. G. McIntosh, G. H. Hally.

Department 5, II Year; 1 lecture per week, both terms, and one three hour drafting board period per week, both terms.

This course of lectures and work on the drafting board is intended to give some acquaintance with the selection of materials and their use in the design and construction of machinery. Machine parts

are analysed as to suitable materials, production methods, the nature and magnitude of the stresses encountered, the standard practice in detailing such parts.

Text book: Machine Design—Berard and Waters.

235. Advanced Machine Design. W. G. McIntosh, G. H. Hally.

Department 3, IV Year; 2 lectures per week, both terms.

The design work averages 7 hrs. per week, the periods to be of not less than 2 hrs. duration.

The lectures of this course deal with the design of machine frames, hooks, hoisting equipment, crankshafts, gears of various kinds (helical, herring-bone, bevel, screw, worm), springs, clutches, brakes, thin and thick-wall vessels. An introduction will be given to the study of dynamic problems connected with the motor car, Diesel engine, and other high speed machinery.

The work in the drafting room is devoted to the design of complete machines, with the object of giving the student practice not only in the design of various details, but also in working the various elements into a machine of smooth and harmonious design. The machines chosen as examples for design involve as many new machine elements as possible, in order to broaden the training of the student.

The laboratory work also involves special shafting problems, including graphical solutions, critical speeds, and multiple supports.

Text book: Design of Machine Elements—Faires.

MATHEMATICS

See Advanced Mathematics, p. 125.

236. Calculus. S. Beatty, D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell, J. C. Mark.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 2 hrs. per week, both terms. Department 7, I Year, one 3 hr. period per week, both terms, for problems.

Derivation of the fundamental formulae of the differential and integral calculus, with early applications to simple problems concerning graphs, areas, volumes, lengths, centres of gravity, and moments of inertia. Problems are dealt with in the drafting room as outlined in courses 166a, 166b, 166c, 166d, 166e, 166f, 166g, and 166h. For Department 7, an additional period of three hrs. per week is provided for problems and exercises, conducted by the Department of Mathematics.

237. Calculus. I. R. Pounder, D. A. F. Robinson, Miss M. E. G. Waddell, D. B. DeLury.

Departments 1, 3, 6 and 7, II Year; 2 hrs. per week, both terms.

Department 7, II Year; one 3 hr. period per week, both terms, for problems.

Continuation of course 236. The elementary theory reviewed and extended. Special attention to applications with problems in engineering mostly in view. Introduction to the study of simple differential equations. Problems are dealt with in the drafting room as outlined in courses 167a, 167b, 167c, 167f, 167g and 167h. For Department 7, an additional period of three hrs. per week, is provided for problems and exercises, conducted by the Department of Mathematics.

238. Analytical Geometry. S. Beatty, D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell, J. C. Mark.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 1 hr. per week, first term, 2 hrs. per week, second term.

The course in Elementary Analytical Geometry covers the more familiar propositions in connection with the straight line, circle, parabola, ellipse and hyperbola. The subject is treated so as to illustrate the general methods of analytical geometry. In addition problems are dealt with in the drafting room as outlined in courses 166a, 166b, 166c, 166d, 166e, 166f, 166g and 166h. A part of the problem time for Department 7 listed under 236 is devoted to problems in analytical geometry.

239. Spherical Trigonometry. J. W. Melson.

Department 1, II Year; 1 hr. per week, first term.

A course of lectures includes the derivation of formulae and their application to the solution of triangles and to practical problems.

Text book: Spherical Trigonometry—Todhunter and Leatham.

240. Method of Least Squares. J. W. Melson.

Department 1, II Year; 1 hr. per week, second term.

The course of lectures includes: The general principles of probability, the law of error, direct measurements of equal and different weights; mean square and probable errors; indirect measurements; conditioned observations; applications to empirical constants and formulae, etc.

Text book: Least Squares—Merriman.

METALLURGY

241. Elementary Metallurgy. G. A. Guess.

Departments 2, 3, 6, 8, 8a and 9, II Year; 1 hr. per week, second term.

A course of about 12 lectures on furnace metallurgy and present practice, with special reference to iron and steel.

242. Fuels and Combustion. G. A. Guess.

Department 8, II Year; 1 hr. per week, both terms.

A lecture course dealing with fuels, their use, preparation, caloric value and combustion.

243. Metallurgy. G. A. Guess.

Departments 2, 6, 8a and 9, III Year; 1 hr. per week, both terms.

Fuels, temperature of combustion, specific heat, conductivity and problems thereon; chimneys, furnaces, refractories, outline of furnace metallurgy and hydro-metallurgy.

244. Physical Metallurgy. J. A. Newcombe.

Departments 3, 5, 6, 7 and 8a, III Year; 2 hrs. per week, second term.

A lecture course on general Physical Metallurgy.

245. Metallurgy. G. A. Guess, J. E. Toomer.

Department 8, III Year; 2 hrs. per week, first term; 1 hr. per week, second term.

A lecture course on General Metallurgy accompanied by 3 hrs. laboratory per week, first term, and 6 continuous hrs. per week, second term.

246. Physical Metallurgy. J. A. Newcombe.

Department 8, III Year; 1 hr. lecture per week, both terms; 3 hrs. laboratory per week, first term.

The physical metallurgy of the common alloys; equilibrium diagrams. Pyrometry. The preparation of alloys. The use of the microscope.

247. Metallurgy. G. A. Guess, J. E. Toomer.

Departments 2 and 6m, IV Year; 1 hr. lecture per week, both terms; 6 continuous hrs. laboratory per week, second term.

General metallurgy and metallurgical problems.

248. Metallurgy Problems. G. A. Guess, J. E. Toomer.

Department 8, IV Year; 2 hrs. lecture and 4 hrs. laboratory per week, both terms.

Metallurgical book-keeping, balance sheets, thermal balance sheets, methods and processes.

249. Metallurgy. G. A. Guess.

Department 8, IV Year; 1 hr. per week, both terms.

Critical reading and discussion of papers and articles, describing metallurgical processes or dealing with plant arrangement and construction. Metallurgical flow sheets of typical plants.

250. Physical Metallurgy. J. A. Newcombe.

Departments 6m and 8, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, both terms.

A continuation of the lectures of course 246, dealing more particularly with the ferrous alloys. Part of the lecture course consists of discussions of photo-micrographs. In the laboratory specimens of the common alloys are microscopically examined and photographed.

251. Physical Metallurgy. J. A. Newcombe, W. L. Sagar.

Department 8, IV Year; 3 hrs. laboratory per week, first term.

The introductory part of this course is intended to give some familiarity with the experimental study of the elastic and physical properties of iron and steel, and in the use of testing machines and instruments of precision designed for that purpose. Following this, carbon and alloy steels are given different heat treatments. The structures developed are examined and photographed, mechanical tests are made and findings correlated.

252. Physical Metallurgy. J. A. Newcombe.

Department 1, II Year; 1 hr. lecture per week, second term.

The physical properties of metals and alloys used in civil engineering practice.

253. Heat Treatment of Iron and Steel. J. A. Newcombe.

Department 3, IV Year; 1 hr. lecture per week, both terms.

The principles underlying the heat treatment and mechanical treatment of carbon and alloy steels. Cast iron.

CERAMICS AND NON-METALLIC MINERALS

254*a*. Non-Metallic Minerals. R. J. Montgomery.

Department 8a, III Year, Department 6c, IV Year; 4 hrs. per week, first term; 2 hrs. per week, second term.

Lectures covering the industrial classification, properties, and utilization of non-metallic minerals. Ceramic plant practice is covered in some detail in the second term.

254*b*. Non-Metallic Minerals Laboratory. R. J. Montgomery.

Department 8a, III Year, Department 6c, IV Year; 6 hrs. per week, first term; 9 hrs. per week, second term.

The physical properties and thermal characteristics of non-metallic minerals are studied from an industrial standpoint.

254*c*. Ceramics. R. J. Montgomery.

Department 8a, III Year; 2 hrs. per week, second term.

Lectures are given on the composition of clear and coloured glazes.

254*d*. Ceramic Calculations. J. E. Toomer.

Department 8a, IV Year; 1 hr. per week, first term.

Lectures and problems on calculations necessary for the compounding of ceramic bodies and glazes.

254*e*. Non-metallic Minerals Laboratory. J. E. Toomer.

Department 8a, IV Year; 6 hrs. per week, first term; 3 hrs. per week, second term.

Laboratory practice in the analysis of non-metallic minerals.

254*f*. Refractories and Ceramic Bodies. R. J. Montgomery.

Departments 6c and 8a, IV Year; 2 hrs. per week, first term; 1 hr. per week, second term.

Lectures on the composition of bodies made using non-metallic minerals with special reference to refractories, whiteware, and porcelain.

254*g*. Glass and Enamels. R. J. Montgomery.

Department 8a, IV Year; 1 hr. per week, both terms.

Lectures on the composition and manufacture of glass and iron enamels.

254*h*. Non-Metallic Mineral Products. R. J. Montgomery.

Department 8a, IV Year; 1 hr. per week, both terms.

Lectures on specifications, testing and methods of testing non-metallic mineral products.

254*i*. Non-Metallic Minerals Laboratory. R. J. Montgomery.

Department 8a, IV Year; 6 hrs. per week, both terms.

Advanced work on the compounding and testing of non-metallic mineral products.

254*j*. Ceramic Building Materials. R. J. Montgomery.

Department 4, IV Year; 1 hr. per week, second term.

Lectures on the composition, manufacture, properties, and use of ceramic building materials.

MINERALOGY

255. Elementary Mineralogy. J. E. Thomson.

Departments 5, 6, 8, and 8a, I Year; 2 hrs. per week, first term.

After introducing the student to the chief chemical, physical, and crystallographic characteristics of minerals, the course becomes descriptive and deals with about one hundred of the minerals most important from the industrial or scientific point of view.

Text book: Text-book of Mineralogy—Dana.

256. Mineralogy. J. E. Thomson.

Departments 2 and 9, I Year. Twenty-five lectures. 2 hrs. per week, first term and part of second term.

After introducing the student to the chief chemical, physical and crystallographic characteristics of minerals, the course deals with about one hundred and twenty-five of the minerals most important from the industrial or scientific point of view, laying particular emphasis on their paragenesis and alteration.

Text book: Text-book of Mineralogy—Dana.

257. Primary Mineralogy. V. B. Meen.

Department 1, II Year; 2 hrs. per week, first term.

A very brief introduction to the study of minerals and rocks.

Text books: Minerals and How to Study Them—Dana. Handbook of Rocks—Kemp.

258. Mineralogy. J. E. Thomson.
Departments 2 and 9, I Year; 1 hr. per week, both terms.
Determination of minerals by inspection and by means of physical tests.
Text book: Mineral Tables—Eakle.

258*a*. Mineralogy. J. E. Thomson.
Departments 5, 8 and 8a, I Year; 1 hr. per week, first term.
Determination of minerals by inspection and by means of physical tests.
Text book: Mineral Tables—Eakle.

258*b*. Mineralogy. J. E. Thomson.
Department 6, I Year; 1 hr. per week, both terms.
Determination of minerals by inspection and by means of physical tests.
Text book: Mineral Tables—Eakle.

259. Mineralogy. V. B. Meen.
Department 1, II Year; 1 hr. per week, first term; 2 hrs. per week, second term.
Determination of minerals by inspection and by means of physical tests; study of common rock types and their identification.
Text books: Mineral Tables—Eakle. Handbook of Rocks—Kemp.

260. Elementary Petrography. V. B. Meen.
Departments 5g and 8a, III Year; 1 hr. per week, both terms.
A course of lectures and laboratory work introducing the student to the macroscopic study of rocks.
Text book: Handbook of Rocks—Kemp.

260*a*. Elementary Petrography. J. E. Thomson.
Departments 2 and 9, I Year. Twenty-five hours. 2 hrs. per week, second term, following course 256.
A course of lectures and laboratory work introducing the student to the macroscopic study of rocks.
Text book: Handbook of Rocks—Kemp.

261. Mineralogy. J. E. Thomson.
Departments 2 and 9, II Year; 2 hrs. per week, both terms.
Determination of minerals by means of the blow-pipe and physical properties.
Text book: Determinative Mineralogy and Blowpipe Analysis—Brush-Penfield.

262. General Petrography. A. L. Parsons.
Departments 2 and 9, III Year, and Departments 5g and 8a, IV Year; 1 hr. per week, both terms.
Study of the chief rock-forming minerals and of some phases of petrography not covered in the course of the previous year.
Text books: Petrology for Students—Harker. Thin Section Mineralogy—Rogers and Kerr.

263. Petrography. V. B. Meen.

Departments 2 and 9, III Year, and Departments 5g and 8a, IV Year; 2 hrs. per week, both terms.

Study of the chief rock-forming minerals, of rocks in thin sections and in hand specimens.

Text books: Petrology for Students—Harker. Thin Section Mineralogy—Rogers and Kerr.

263*a*. Petrographic Methods. M. A. Peacock.

Department 9, IV Year; 2 hrs. per week lectures and laboratory, both terms.

Methods for determining microscopic mineral powders.

Reference book: The Microscopic Determination of the Non-opaque Minerals—Larsen and Bearman.

263*b*. Mineralography. J. E. Thomson.

Department 9, IV Year; 2 hrs. laboratory per week, both terms.

The study of opaque minerals by microscopic methods with reflected light.

Reference book: Determination of the Opaque Minerals—Farnham.

264. Mineralogy. M. A. Peacock.

Department 5s, IV Year; 1 hr. lecture per week, both terms.

A lecture course on morphological crystallography.

Reference book: Text book of Mineralogy—Dana.

MODERN LANGUAGES

265. German. H. Boeschenstein.

Department 6, I Year, 2 hrs. per week, both terms; II, III and IV Years, 1 hr. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

265*a*. German. C. Barnes.

Department 5, I Year; 2 hrs. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: First German Course for Science Students—Fiedler and Sandbach.

265*b*. German. C. Barnes.

Department 5, II Year; 1 hr. per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: Second German Course for Science Students—Fiedler and Sandbach.

266. Spanish.

Department 6m, IV Year; 1 hr. per week, both terms.

An introduction to Spanish grammar, pronunication and practice in reading Engineering Spanish.

MUNICIPAL ENGINEERING

267. Sanitary Engineering. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. lecture per week, both terms.

267a. Sanitary Engineering. A. E. Berry, W. J. Smither.

Department $1a_1$, IV Year; 3 hrs. laboratory per week, second term (course 179).

Consideration is given to the problems of water supply, sewerage and municipal sanitation as viewed by the engineer. The lectures and laboratory work include the design of water distribution and sewer systems, as well as water and sewage treatment works. Problems are assigned from assumed data and from material secured in the field. Excursions to places of interest are also arranged from time to time.

Reference books: Public Water Supplies—Turneaure and Russell. Manual of Water Works Practice of the American Water Works Association. American Sewerage Practice—Metcalf and Eddy, 3 vols. Solving Sewage Problems—Fuller and McClintock.

268. Highway Engineering. W. L. Sagar.

Department $1a_1$, IV Year; 1 hr. lecture and 3 hrs. laboratory per week, second term.

The course of lectures deals with the fundamentals of highway design, and with the types and properties of the materials employed. The theory of soil stabilization is discussed, and the design of stabilized mixtures and pavements of the flexible and rigid types considered in some detail. The laboratory deals with subsoils, bituminous and non-bituminous materials of construction.

Text books and references: Construction of Roads and Pavements—Agg. Rural Highway Pavements—Harger. Principles of Highway Engineering—Wiley. Public Roads—U.S.D.A.

RAILWAY ENGINEERING

269. Railway Engineering. W. M. Treadgold.

Department $1a_2$, IV Year; 1 hr. per week, first term, 2 hrs. per week, second term, and 4 hrs. per week, second term, in the drafting room.

This course of lectures and practical work is intended to make the student acquainted with the general principles of railway engineering and transportation. The economic theory of location, train resistance, effect of grade distance and curvature rise and fall, maintenance of way, yards and terminals, tunnels and street railway practice; also the principles of urban and interurban transportation.

Text books and references: The Economic Theory of Railway Location—A. M. Wellington. Proceedings of the Railway Engineering Association.

269*a*. Railway Structures. C. R. Young.

Department $1a_2$, IV Year; 1 hr. lecture per week, first term; 2 hrs. laboratory per week, second term (course $178a_2$).

A course of lectures with exercises covering alternative bridge layouts with comparative estimates of costs, temporary and permanent trestles, tunnels, tunnels vs. bridges, buildings, turn-tables, snow-sheds and shelters.

SURVEYING

270. Surveying. S. R. Crerar.

Departments 1, 2 and 9, I Year; 1 hr. per week, both terms.

Departments 3, 7, 8 and 8a, I Year; 1 hr. per week, first term.

The lecture course includes the general principles and practice of surveying with the chain, the transit, and the level with special attention given to co-ordinate surveying.

Text books: Plane Surveying—Tracy. Elementary Surveying —Breed and Hosmer.

270*a*. Surveying. T. L. Rowe.

Department 4, I Year; 1 hr. per week, first term.

The lecture course includes the general principles and practice of surveying with the chain, the transit, and the level, with special consideration given to the survey of lots and small estates.

271. Field Work. S. R. Crerar, J. W. Melson, T. L. Rowe.

Departments 1, 2 and 9, I Year; 6 hrs. per week, first term.

Departments 3, 7, 8 and 8a, I Year; 6 hrs. per week to December 1.

This course comprises practice in chaining; a complete survey of a piece of land with the chain and transit; keeping of field notes; the use of the transit in surveying closed figures and traverse lines and in ranging straight lines; plotting by latitudes and departures and otherwise computing areas; instrumental work with the level; also use of level and transit in setting out a proposed building and calculating the volume of excavations required.

271*a*. Field Work. T. L. Rowe.

Department 4, I Year; 3 hrs. per week, first term.

This course comprises practice in chaining, a complete chain survey of a small estate, keeping field notes, the use of the transit and level and their application in building layouts, cross section work with the level, including calculation for excavations.

272. Surveying. W. M. Treadgold.

Department 1, II Year; 1 hr. per week, both terms.

This course of lectures takes up in detail, simple, reverse and compound curves as applied to railroad and highway surveying. It also includes stadia, plane table and photographic surveying as applied to topographic work, and the main features of mine and hydrographic and aerial surveying.

Text books: Henck, Searles, Allen (Field books for Engineers) Theory and Practice of Surveying—Davis, Foote and Rayner. Surveying—Breed and Hosmer.

272a. Surveying. E. W. Banting.

Departments 2 and 9, II Year; 1 hr. per week, both terms.

This course of lectures takes up mine surveying with problems related thereto. It also includes simple curves, stadia and plane table topographical surveying.

Text books: Surveying—Breed and Hosmer. Mine Surveying Durham.

273. Field Work. W. M. Treadgold, E. W. Banting.

Department 1, II Year; 9 hrs. per week, first term.

Departments 2 and 9, II Year; 6 hrs. per week, first term.

This course of instruction embraces all adjustments of the transit and level, minor problems in triangulation and traversing, levelling and plane table practice, curves and topography.

274. Surveying. W. M. Treadgold.

Department 1, III Year; 1 hr. per week, both terms.

This course of lectures takes up the work of the railroad engineer on construction, including profiles, cross-sectioning, computation of volume of earthwork, overhaul, transition curves, laying out turnouts, frogs and switches, etc. Also a discussion of trigonometric and barometric levelling.

Text books: Field Engineering—Searles. Railroad Curves and Earthworks—Allen. Route Surveying—Pickles and Wiley.

Photographic Surveying, see 189, 189a.

275. Survey Camp. W. M. Treadgold, S. R. Crerar, E. W. Banting, J. W. Melson, E. S. Moore.

Departments 1, 2 and 9, III Year; Department 1b, IV Year.

The University of Toronto Survey Camp is ideally located in County of Haliburton at an elevation of 1,000 feet above sea level and comprises a tract of field, woodland and lake front property. The country is broken and rolling and with the numerous small lakes and streams in the immediate vicinity is admirably suited for work and the various problems that arise in practical surveying. Since the camp has been established, Professor Stewart has made a careful triangulation survey, establishing triangulation stations near the camp connected with primary stations of the Geodetic Survey of Canada. This triangulation has been adjusted and complete computations made. Also through the interest and co-operation of Mr. Noel Ogilvie, Director of the Geodetic Survey, permanent bench marks were established at Miner's Bay on Gull Lake, connecting up levels with the precise level net of Canada.

By rail the camp may be reached by taking the Canadian National train leaving Lindsay for Haliburton, getting off at Gelert, where conveyances are always on hand to drive to the camp, a distance of 12 miles, by way of Minden, the county town.

All mail, telegrams, or telephone messages should be addressed to the "University Survey Camp, Minden, Ontario". Baggage should be checked to Minden via Gelert on the Canadian National Railway.

Each student will provide at least three pairs of heavy blankets, sheets, towels, raincoats, personal supplies, all of which should be limited to about 60 lbs., and carried in suit cases or dunnage bags.

This course includes:

(*a*) Secondary Triangulation and Base Line Measurements.

(*b*) Stadia, Plane Table and Boundary Traverses.

(*c*) Highway and Railway Location.

(*d*) Cross Sectioning and Computation of Earthwork.

(*e*) Stream Gauging and Discharge Measurements.

(*f*) Hydrographic Surveying.

(*g*) Photographic and Micrometer Work.

(*h*) Stadia and Plane Table Topography.

(*i*) Mine Surveying.

(*j*) Observations for Time, Azimuth and Latitude.

(*k*) Geological Survey.

A complete field course in Practical Astronomy and Geodesy is given to students taking this option in the Fourth Year, Department of Civil Engineering including the adjustment of a triangulation, observations for time, latitude and azimuth and base line measurements.

Students in Departments 1, 2 and 9 will be required to take the Survey Camp between the Second and Third Year; and, on failure to do so, this subject will be carried as a supplemental in the Third Year.

PRACTICAL EXPERIENCE

276. Practical Experience.

Department 7.

Each student registered in the Department of Electrical Engineering is required to submit to the Secretary of the Faculty, not later than January 15th in each session, certificates and a detailed report regarding practical experience. Certificate forms, the nature of the report, and information regarding the kinds of experience to be sought, are available at the office of the Secretary.

PHYSICAL TRAINING

280. Physical Training. G. D. Porter.

Required in all Departments, I and II Years, and optional in the III and IV Years.

By order of the Board of Governors, each male undergraduate proceeding to a degree must take Physical Training in the first and second academic years of his course. In each session in which Physical Training is compulsory he must first undergo a medical examination by the Director of the University Health Service, and must then register for Physical Training at the office of the Athletic Association in Hart House. Students of all years who wish to take part in any form of athletics or physical exercise, must first undergo a medical examination by the Director. Those classified as A1 may elect to take any form of competitive athletics during the season in which that form of sport is in progress.

Military training in the C.O.T.C. constitutes an option in Physical Training (see page 168).

ZYMOLOGY

283. Zymology. A. M. Wynne.

Department 6z, IV Year.

A study of the phenomena of fermentation and of the mechanism of enzyme action.

THESIS

285. Thesis.

Required in all Departments, IV Year, with the exception of Department 4, Architectural Design Option and Departments 5g and 5i. Department 3, IV Year; 1 hr. per week, both terms. For requirements in Department 2, see course 67, and in Department 6, see course 113.

Each student must prepare a thesis on a subject and in a form approved by the head of the department in which the student is registered.

ADVANCED MATHEMATICS

See Mathematics, p. 114

Elective courses in Mathematics are offered to students of the I and II Years. Students of the I Year will be informed at the beginning of the fall term whether or not they are qualified to proceed with the advanced course. Those who take this course will try the ordinary pass examination papers, plus an advanced problem paper at the end of the year. The pass standing for proceeding to the Second Year will be determined by the ordinary paper, the marks of the problem paper being used to determine whether or not the student has shown sufficient proficiency to take the advanced work of the Second Year.

Students of the Second Year taking the advanced course will try the ordinary pass examination papers plus an advanced problem paper, pass standing being determined by the ordinary papers and proficiency for further advanced work by the problem paper.

Although these courses are entirely elective, students who are qualified to take them are urged to proceed with this work.

The names of those who pass these advanced papers will be published with the regular results each year as having completed these courses.

290. Advanced Mathematics. The Staff in Mathematics.

Departments 1, 2, 3, 4, 6, 7, 8, 8a and 9, I Year; 3 hrs. lecture per week, first term; 4 hrs. lecture per week, second term.

Department 7, I Year, one 3 hr. period per week, both terms for problems.

In addition to the regular material included under courses 236, 238, students will take work on advanced problems on conics; parametric equations on conics; curve tracing and asymptotes; circular and hyperbolic functions; expansions of functions of one variable; partial fractions; elementary theory of equations; determinants up to the third order; one-parameter families of curves and their differential equations; differential equations in elementary mechanics; curve fitting and approximate integration.

291. Advanced Mathematics. The Staff in Mathematics.

Departments 1, 3, 6, and 7, II Year; 2 hrs. lectures per week, both terms.

Department 7, II Year, one 3 hr. period per week, both terms for problems.

In addition to the regular material included under course 237, students will take work on elementary space geometry; partial differentiation; expansions of functions of more than one variable; multiple integration; ordinary differential equations of first order and first degree; linear differential equations with constant coefficients; applications to problems in mechanics.

292. Algebra and Calculus. J. D. Barber.

Department 5, I Year; 3½ hrs. per week, both terms.

Polynomials and rational functions, elementary theory of equations, inequalities, determinants, limits, summation of series, binomial, exponential, and logarithmic series, expansions of the circular and hyperbolic functions and their inverses, the methods and operations of the Calculus considered intuitively and illustrated by applications, and elementary differential equations.

Text book: Introduction to the Calculus—Osgood.

293. Analytical Geometry of the Plane. J. D. Barber.

Department 5, I Year; 1½ hrs. per week, both terms.

Cartesian and polar coordinates, transformation of coordinates,

straight lines and curves of the second degree, projective properties of conics, the principle of duality, higher plane curves.

Text book: Analytical Geometry—Nowlan.

294. Differential Calculus. S. A. Jennings.

Department 5, II Year; 3 hrs. per week, both terms.

Differentiation, Taylor's theorem and series for functions of one or more variables, families of curves and surfaces and their differential equations, Jacobians, geometrical and mechanical applications.

Text books: Introduction to the Calculus—Osgood. Differential and Integral Calculus, Vol. I—Courant.

295. Integral Calculus and Differential Equations. S. A. Jennings.

Department 5, II Year; 3 hrs. per week, both terms.

The indefinite integral, integration of rational and other special functions, the definite integral, differentiation with respect to a parameter, multiple integration, Fourier's series, geometrical and mechanical applications, approximate integration, introduction to ordinary differential equations.

Text books: Introduction to the Calculus—Osgood. Differential and Integral Calculus, Vol. I—Courant.

296. Analytical Geometry of Space. S. A. Jennings.

Department 5, II Year; 1 hr. per week, both terms.

Cartesian and other systems of point coordinates, curves and surfaces and their equations in parametric or non-parametric form, data fixing planes, lines, conics, and quadrics, generating lines and circular spectrons of quadrics, classification of quadrics, tangent cones to quadrics, metric and projective properties of quadrics, families of quadrics, ruled surfaces and surfaces of revolution.

Text book: Analytic Geometry—Nowlan.

297. Differential Equations. R. Brauer.

Department 5, III Year; 1 hr. per week, both terms.

First order equations solvable by quadratures, depression of the order, the linear equation, systems of linear equations with constant coefficients, first order partial equations in two variables, total differential equations, particular equations of the second order.

Text books: Differential Equations—Piaggio. Differential Equations—Cohen.

298. Introduction to the Theory of Functions. R. Brauer.

Department 5, III Year; 1 hr. per week, both terms.

Green's and Stokes's Theorems, conformal mapping of one plane region on another, the complex variable, analytical functions, Cauchy's Theorem and Integral Formula, Poisson's Formula, Taylor's and Laurent's series.

Text book: Theory of Functions—Rothe, Ollendorff, and Pohlhausen.

PHYSICS

301. Properties of Matter, Mechanics, and Heat. John Satterly.

Department 5, I Year; 3 hr. lecture per week and 4½ hrs. laboratory per week, both terms.

This course involves lectures and laboratory work supplementing the work taken in the lectures. In addition to the work in the divisions indicated in the title, the course also includes lectures and problems on calculations for science students involving the use of the elementary calculus and statistics. The course is planned in conjunction with the work taken under the title of Engineering Mechanics.

Reference books: Dynamics—Duncan and Sterling. Heat—Gray. Analytical Mechanics—Barton. Mechanics of Fluids—Barton. Properties of Matter—Wagstaff. Heat—Stewart and Satterly. Heat—Draper. Mathematical and Physical Tables—Clark. Calculus made easy—Thompson. Theory of Measurements—Tuttle and Satterly.

302. Elementary Magnetism and Electricity. L. Gilchrist.

Department 5, II Year; 1 hr. lecture per week, first term; 2 hrs. lecture per week, second term.

This course deals with the fundamental theory of magnetism and electricity, including the introduction of electron theory and alternating currents.

Reference books: Advanced Text-book of Magnetism and Electricity—Hutchinson. A treatise on Electricity—Pidduck. Electricity and Magnetism—Starling. Mathematical Physics, Vol. I—Barlow.

303. Elementary Light. H. A. McTaggart.

Department 5, II Year; 1 hr. lecture per week, both terms.

This course deals with the fundamental theory of light, including treatment of interference, diffraction, polarized light, and the introduction of geometrical optics.

Reference books: Light for Students—Edser. Introduction to Physical Optics—Robertson. Optical Measuring Instruments—Martin.

304. Acoustics. E. F. Burton.

Department 5, II Year; 1 hr. lecture per week, first term.

This course deals with the fundamental theory of acoustics, including stationary waves and elementary treatment of architectural acoustics and sound transmission.

Reference books: Science of Musical Sounds—D. C. Miller. Speech and Hearing—Fletcher. Sound—A. B. Wood. Acoustical Engineering—West. Sound—F. R. Watson.

305. Magnetism and Electricity, Light, and Acoustics.

Department 5, II Year; 3 hrs. laboratory per week in the first term, and 6 hrs. laboratory per week in the second term.

This laboratory work is carried out under the direction of the staff in Physics and covers lectures dealt with in courses 302, 303 and 304.

306. Mathematical Operations Applied to Physics. C. Barnes.

Departments 5c, 5s, 5h, 5e, 5i, IV Year; 1 hr. lecture per week throughout the year.

This course involves an account of vectors illustrated by the application of vector algebra to physical problems, and an elementary treatment of such things as Fourier Series and Spherical Harmonics.

307. Theory of Potential and Electrical Measurements. E. F. Burton.

Departments 5c, 5s, 5g and 5i, III Year; 1 hr. lecture per week throughout the year.

This course deals with the elementary theory of potential as applied particularly to electricity and magnetism.

Reference books: Electricity and Magnetism—Starling. Principles of Electricity—Page and Adams.

309. Properties of Matter. John Satterly.

Department 5, III Year; 2 hrs. lecture per week throughout the year.

This course involves advanced work on properties of matter, dealing very intensively with gravitation, elasticity, viscosity, surface tension and kinetic theory of gases.

Reference books: Properties of Matter—Poynting and Thomson. General Properties of Matter—Newman and Searle. Applied Mathematics—Perry. Experimental Physics—Searle. Practical Physics—Watson. The Mechanical Properties of Fluids—Drysdale and others.

310. Heat. John Satterly.

Departments 5c, 5s, 5g, 5h and 5i, III Year; 1 hr. per week, both terms.

A study of thermometry and pyrometry, the absolute scale of temperature, the mechanical equivalent of heat, the kinetic theory of gases, equations of state, low temperature work, specific heats, vaporization, fusion, expansion, transfer of heat by conduction and convection; radiation and radiation pyrometry, the second law of thermodynamics and its simple applications.

Reference books: Heat and Thermodynamics—Roberts. Methods of Measuring Temperature—E. Griffiths.

311. Physical Laboratory.

Department 5, III Year; 3 hrs. laboratory per week, both terms.

This laboratory work includes experiments illustrating the principles involved in the four preceding courses.

312. Optics. H. A. McTaggart, K. B. Jackson.

Departments 5c, 5s, 5g, 5e and 5i, III Year; 1 hr. lecture and 3 hrs. laboratory per week throughout the year.

This course deals with geometrical and physical optics and photometry as applied to optical instruments and with photography as a scientific implement.

Reference books: Optical Measuring Instruments—Martin. Photometry—Walsh.

313. Hydrodynamics. H. A. McTaggart.

Department 5h, III Year; 1 hr. per week, both terms.

A lecture course for beginners on the hydrodynamics of a perfect fluid with applications to motion in liquids and gases. Reference will be made to some of the simpler cases of viscous flow. The course will be illustrated by experiments.

Text books: Treatise on Hydromechanics—Ramsay. Aerofoil and Airscrew Theory—Glauert. The Physics of Solids and Fluids—Ewald, Poschl and Prandtl. Hydro and Aeromechanics—Prandtl-Tietjens.

315. Conduction through Gases, Radioactivity and Atomic Structure. John Satterly.

Departments 5c and 5s, IV Year; 1 hr. per week, both terms.

Kinetic theory of gases, electrical discharge through gases, the electron, elementary X-rays and crystal structure, ionization, the development of radioactivity and its use in the physical and geological sciences.

Text: Ions, Corpuscles and Ionizing Radiations—Crowther.

Reference books: The Atom—Andrade. Radioactivity—Chadwick. Radioactivity—Rutherford. Heat—Poynting and Thomas.

316. Advanced Acoustics. D. S. Ainslie.

Departments 5c, 5s and 5i, IV Year; 1 hr. per week, first term.

This course deals with the properties and transmissions of acoustical waves. It will bring out the analogies in alternating current theory and other fields in physics. Sound resonance and sound filters.

Texts: Acoustics—Stewart and Lindsay. Applied Acoustics Olson and Massa. Acoustical Engineering—West.

317. Physical Laboratory. H. J. C. Ireton.

Department 5c, IV Year; 3 hrs. per week, both terms.

Department 5s, IV Year; 9 hrs. per week, both terms.

This laboratory course is designed to accompany the lecture courses 315, 316, 318, 319 and 321.

318. Advanced Optics. H. A. McTaggart, H. J. C. Ireton.

Department 5s, IV Year; 1 hr. per week, both terms.

A lecture course on the aberrations in optical instruments and on the interference, diffraction and polarisation of light with practical applications.

Texts: Applied Optics—Martin. Course d'Optique—Bruhat. The Diffraction of Light, X-Rays, etc.—Meyer. Applied Optics and Optical Design—Conrady.

319. Series Spectra. H. J. C. Ireton.

Department 5s, IV Year; 1 hr. per week, second term.

A lecture course outlining the early developments in atomic spectroscopy, the origin of spectral lines, and their empirical classification into series. The application of the derived formulae to hydrogen, helium and the alkali metals is given.

Reference books: Introduction to Modern Physics—Richtmeyer. Introduction to Atomic Spectra—White.

320. Elementary Quantum Theory. Miss E. J. Allin.

Department 5s, IV Year; 1 hr. per week, second term.

The fundamental principles of the quantum theory developed from a historical and experimental standpoint, radiation formulae, photoelectric effect, Compton effect, specific heats.

Reference book: Théorie des Quanta—Bloch.

321. X-Rays and Crystal Structure. H. J. C. Ireton, J. O. Wilhelm.

Department 5s, IV Year; 1 hr. per week, both terms.

The fundamental physical principles of X-rays, their production, properties and applications to the study of crystalline structure. The practical significance of the results obtained is outlined.

Reference books: The Crystalline State—Bragg and Bragg. Applied X-rays—Clark.

322. Geophysics. L. Gilchrist.

Department 5g, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, both terms.

Department 9, IV Year; 2 hrs. lectures, 6 hrs. laboratory per week, both terms.

The course involves a study of the physical principles underlying the methods of investigating surface geological structure and the location of mineral deposits. Particular attention is given to magnetic, electrical, electromagnetic, gravitational, seismological, thermometric and radioactive methods of investigation. In the laboratory, experiments which are illustrative of the methods are carried out and typical problems are investigated.

Reference books: A Manual of Seismology—Davison. Modern Seismology—Walker. Lehrbuch der Geophysik—Gutemberg. Elements of Geophysics—Ambronn. Applied Geophysics—Eve and Keys. Geophysical Prospecting, 1929—A.I.M.E. Geophysical Prospecting, 1932—A.I.M.E. Geophysical Prospecting, 1934—A.I.M.E. Publications of Geological Survey, Department of Mines, Ottawa, Memoirs, 165, 170.

323. Wave Motion in Elastic Media. L. Gilchrist.

Departments 5g and 5e, IV Year; 1 hr. per week, both terms.

The course involves the development of the differential equations for the propagation of various types of disturbance through different media. A study is made of the solution of these equations having regard to the initial and final conditions and the boundary conditions of the media associated with the propagation of the disturbance. Typical problems are considered such as (*a*) the propagation of vibrations in strings, rods, membranes and plates, (*b*) the propagation of heat and electricity in planes, cylinders and spheres.

Reference books: Fourier's Series and Spherical Harmonics—Byerly Spherical Harmonics—MacRobert.

324. Physics of Light Production—H. J. C. Ireton.

Department 5i, IV Year; 1 hr. per week, both terms.

A course of lectures dealing with black body radiation, spectral energy distribution and the principles involved in the production of light in various types of sources, filament, flame, and gaseous and vapour tubes.

325. Physical Laboratory. H. J. C. Ireton.

Department 5i, IV Year; 3 hrs. per week, both terms.

A laboratory course to accompany Course 324.

326. Dynamic Meteorology. B. Haurwitz.

Department 5h, IV Year; 1 hr. per week, both terms.

A lecture course intended as an introduction to meteorology applicable to aeronautics. It will deal in elementary form with the statics, dynamics and thermodynamics of the atmosphere. Particular emphasis will be laid on the points which are most important for airplane flight, such as atmospheric turbulence, atmospheric conditions producing an ice coat on airplanes and the interpretation of weather reports and weather maps.

APPLIED MATHEMATICS

331. Theoretical Mechanics. J. L. Synge.

Department 5, III Year; 1 hr. per week, both terms.

The course deals with the dynamics of a particle on a curve and in two dimensions and the dynamics of rigid bodies in two-dimensional motion.

Text-book: Dynamics—Lamb.

332. Differential Equations of Mathematical Physics. A. F. Stevenson.

Department 5, IV Year; 2 hrs. per week, both terms.

The course deals with the underlying theory and with important particular equations, and includes separation of variables, eigenvalues and eigenfunctions, Fourier series, Laplace's equation, Bessel's equation, wave equation (including vibration of strings and membranes, sound waves, electromagnetic waves), equation of heat conduction, Green's function.

333. Theory of Elasticity. J. L. Synge.

Department 5e, IV Year; 1 hr. lecture and 1 hr. laboratory per week, both terms.

The course covers the more fundamental parts of the mathematical theory of elasticity and includes a general discussion of strain, finite and infinitesimal, and of stress, stress-strain, relations for an isotropic body, equations of equilibrium, shell or tube under pressure, torsion and flexure, strain-energy function, anisotropic bodies and cases of elastic symmetry.

334. Theoretical Hydrodynamics. J. L. Synge.

Department 5h, IV Year; 2 hrs. per week, both terms.

The course deals with the theory of the motion of perfect and viscous fluids including irrotational motion in two and three dimensions, dynamics of solids and liquids, vortices, viscous flow in tube and between parallel planes, Couette motion, equations of Stokes and Oseen.

Text book: Treatise on Hydromechanics, Part II—A. S. Ramsey.

335. Dynamics. B. A. Griffith.

Department 7, II Year; 1 hr. lecture and 1 hr. problems per week, both terms.

A course in theoretical dynamics including the motion of a particle on a straight line and in a plane, simple harmonic motion, the circular pendulum, projectiles, centre of gravity, moments of inertia, motion of a rigid body about a fixed axis, impulsive motion, problems on rolling and sliding.

Text book: An Introduction to Mechanics—J. W. Campbell.

AERONAUTICS

341. Aircraft. T. R. Loudon.

Department 5h, III Year; 1 hr. lecture per week, both terms; 3 hrs. laboratory per week, second term.

This is an introductory course in which the various types of aircraft and their component parts are described. The principles of flight are gone into and an elementary discussion of aerodynamic forces and coefficients is given.

Text book: Technical Aerodynamics—Wood.

342. Aerodynamics. T. R. Loudon, M. J. C. Lazier.

Department 5h, IV Year; 2 hrs. per week, both terms.

This course of lectures extends the theory of hydrodynamics to the case of theoretical determination of forces resulting from flow around an airfoil. The theory of model testing and scale effect is discussed and a complete analysis is made of conditions of longitudinal and lateral stability. The problem of the lighter than air craft is also discussed.

Text books: Aerofoil and Airscrew Theory—Glauert. Technical Aerodynamics—Wood. Airplane Design—Warner.

344. Airplane Design and Stress Analysis. T. R. Loudon, C. F. Morrison.

Department 5h, IV Year; 2 hrs. lecture, 9 hrs. laboratory per week, both terms.

The more advanced theory of structural design is gone into as a continuation of Course 7, III Year. The properties of materials used in aircraft construction are discussed; and problems are worked out on the design of aircraft for given aerodynamic and structural specifications.

Text books: Technical Aerodynamics—Wood. Airplane Structures—Niles and Newell.

345. Hydrodynamics. T. R. Loudon, M. J. C. Lazier.

Department 5h, IV Year; 6 hrs. laboratory per week, both terms.

This course is intended to amplify the lecture courses on hydrodynamics and aerodynamics. The calibration and practical use of wind tunnel instruments is explained, and a series of experiments is carried out on the determination of forces and moments acting on various airfoil arrangements.

SECTION X. EXAMINATIONS

ANNUAL

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in all subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations are 50 per cent. in the Department of Engineering Physics and 40 per cent. in all other Departments, with an average of 50 per cent. The pass marks required in the laboratory work of all Departments are 60 per cent. In the Department of Engineering Physics an average of 60 per cent. will be required in the written and practical work of the Second, Third and Fourth Years. Candidates who have attained the required average and who have failed in not more than two subjects will be required to pass supplemental examinations in those subjects to secure pass standing.

5. Honours will be granted to students who, at the annual examinations, obtain at least 50 per cent. in each written subject, at least 60 per cent in each laboratory subject, and 75 per cent. of the total number of marks allotted to the subjects of their course.

6. Honour graduate standing will be granted to those who obtain honours in the final and in one previous year.

7. Candidates who fail to secure promotion in any year will be required to take again the whole course of instruction of the year in which they fail before presenting themselves a second time for examination.

8. A student failing in the First or Second Year of the Department of Engineering Physics will not be permitted to repeat the year in this Department.

9. A student who, in either term of the session, fails to perform satisfactorily the work of his course may not be allowed to present himself at the final examinations of the year.

10. A student should submit to Council immediately after its occurrence evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day of examinations.

11. A student who has failed to complete satisfactorily the course in Physical Training prescribed for the First Year will not be permitted to register in the Third Year; and the student who has failed to complete satisfactorily the course in Physical Training prescribed for the Second Year will not be permitted to register in the Fourth Year.

12. A student will not be allowed to write any examination if he has not paid all fees and dues for which he is liable at that time.

13. Unless special permission is granted by the Council of the Faculty concerned, a student will not be permitted further registration in the University if, at the end of two sessions spent in the same year of the Faculty in which he is registered, he has failed to obtain the standing necessary to qualify him for registration in the succeeding year of the Faculty. An appeal from the decision of the Faculty Council may be made to the Senate.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on the 13th day of September, 1938. Application (on the prescribed form) to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 15th, and the fee named in Sec. VI, para. 5 received by the Bursar not later than September 1st. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements. Arrangements will be made to conduct supplemental examinations at the Survey Camp for those students in attendance at the camp.

2. If a candidate desires to write upon an annual examination as a supplemental, his application must be received by the Secretary and his fee by the Bursar, for the January examinations not later than December 1st and for the April examinations not later than March 1st.

3. Pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

4. Under special circumstances, a candidate who has failed to obtain pass marks in one written supplemental examination may, at the discretion of Council, be permitted to enter the next higher year.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

SECTION XI. SCHOLARSHIPS

Through the generosity of friends of the University, encouragement has been given to both undergraduate and graduate work in its various branches, by establishing the following scholarships, prizes, bursaries and medals.

A student will not be allowed to hold more than one of the following scholarships marked with an asterisk, but the published lists will show all those to which he would have been entitled, but for this provision. The Council may, at its discretion, award unallotted scholarships to the next eligible candidate.

Name	Years eligible	Amount	See page
*Baptie Scholarship	I	$100	138
*Harvey Aggett Memorial Scholarship	II	$75	138
*Boiler Inspection & Insurance Co. Scholarship	III	$150	138
*Jenkins Scholarship	III	$100	138
B.A.A.S. Medal	IV	....	139
Toronto Architectural Guild Medal	V	....	139
O.A.A. Scholarship	II	$100	139
Toronto Brick Company Prizes	IV	$75 & $25	139
Darling and Pearson Prize	V	$100	139
Heating and Ventilating Engineers Prize	III, IV	$25	140
E. I. C. Prize	III	$25	140
*Ceramics Scholarship	III	$50	140
MacLennan-MacLeod Memorial Prize	I	$25	140
J. A. Findlay Scholarships	II, III	....	141
R.A.I.C. Medal	V	....	141
*Ransom Scholarship in Chemical Engineering	I	....	141
Rhodes Scholarships	II, III, IV	£400	142
Ubukata Fund	All	....	142
F. W. Jarvis Bursary	All	$50	143
U. of T. War Memorial Scholarships	All	$200	143
U. of T. War Memorial Fellowships	Graduate	$500	143
McCharles Prize	All & Grad.	$1,000	144
1851 Exhibition Science Research Scholarship	Graduate	£275	145
Nipissing Mining Co. Research Fellowship	Graduate	$1,100	146
Elizabeth Speller Memorial Fund	III, IV	....	146
Engineering Society Loan Fund	....	....	146
T. H. Bickle Bursary	All	....	146

NOTE: On account of the continued tendency towards lower rates of interest it is possible that the value of certain scholarships or prizes at the time of payment may prove to be less than the amount stated in the calendar.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that from the income therefrom a scholarship of One Hundred Dollars shall be awarded to engineering students on the record of their first year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the Annual Examinations of the First Year, enrolled in any one of the departments of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those departments. The first award was made on the results of the annual examinations of the Session 1925-26.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of Seventy-five Dollars is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a Scholarship in the Department of Mechanical Engineering of the value of One hundred and fifty Dollars to the student who obtains highest Honour Standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Bursar to the fees of the Fourth Year of the successful candidate.

JENKINS SCHOLARSHIP IN ENGINEERING

The Jenkins Scholarship in Engineering, presented by Jenkins Bros., Limited, has been donated to continue for a period of fifteen years, the first award having been made in 1925.

This annual scholarship, of the value of One Hundred Dollars, is to be awarded to the student of the Third Year registered in one of the six departments of Civil, Mining, Mechanical, Chemical, Electrical or Metallurgical Engineering, who has the highest aggregate of percentages for the First, Second and Third years.

B.A.A.S. MEDAL

A bronze medal has been donated for students of the Faculty of Applied Science and Engineering by members of the British Association for the Advancement of Science. This Medal will be awarded to the student of the Fourth Year, in any department, who, taking honours, obtains the highest aggregate percentage in practical and written examinations in the year.

TORONTO ARCHITECTURAL GUILD MEDAL

The Toronto Architectural Guild was the organization of local architects from which sprung the Ontario Association of Architects. When the new and wider association became firmly established, the Guild disbanded and handed over to a trustee board certain funds for the establishment of a medal to be awarded in the School of Architecture of the University of Toronto.

The Trustee Board, now that the fund has accumulated considerably, announces its intention of awarding this medal annually to a senior student showing outstanding ability in Architectural Design.

ONTARIO ASSOCIATION OF ARCHITECTS SCHOLARSHIP

The Ontario Association of Architects offers a scholarship of One Hundred Dollars to the student of the Second Year in the School of Architecture who at the annual examinations obtains the highest honour standing in Architectural Design. The scholarship was awarded annually from 1928 to 1935 inclusive and has been extended for a further period of five years.

TORONTO BRICK COMPANY PRIZES

The Toronto Brick Company offers two prizes, one of Seventy-five Dollars and one of Twenty-five Dollars to those students of the Fourth Year in the School of Architecture who win first and second places in a competition arranged by the Staff in the School of Architecture for this purpose.

DARLING AND PEARSON PRIZE IN ARCHITECTURE

Messrs. Darling and Pearson, Architects, offer annually a prize of One Hundred Dollars in books to the student in the final year of the School of Architecture who is assigned the highest marks in a special problem in Architectural Design, set for this purpose by the School of Architecture. The books constituting this prize are to be selected by the successful candidate, with the approval of the School of Architecture.

The first award of this prize was made in the Session 1927-28.

HEATING AND VENTILATING ENGINEERS PRIZE

The Ontario Chapter of the American Society of Heating and Ventilating Engineers offers an annual prize of Twenty-five Dollars for a period of five years commencing 1931. The period was extended indefinitely in 1935. The prize will be awarded to the student in either the Third or Fourth Year in the Department of Mechanical Engineering who, in the opinion of that Department, has written the most satisfactory thesis on subjects dealing with Heating and Ventilation, such thesis being prepared under special arrangement made by the Department, the result to be reported to Council at the time of the annual examination results. The thesis must be handed in not later than March 1st. The prize will not necessarily be awarded in any year.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional knowledge among its members, offers an annual prize of Twenty-five Dollars in this University, to continue for a period of five years, commencing 1931, to the student who in his Third Year in any one of the six Departments of Engineering has proved himself most deserving as disclosed by the examination results of the year in combination with his activities in the Engineering Society, or with a local branch of another recognized engineering organization. This prize was extended in 1935 for a further period of five years.

CERAMICS SCHOLARSHIP

The Canadian Ceramic Society offers an annual scholarship of the value of Fifty Dollars for a period of ten years commencing 1932, to be known as "The Ceramics Scholarship." The scholarship will be awarded to the student in the Third Year in the Department of Metallurgical Engineering enrolled in the Ceramics Option, who has obtained the best academic standing. An award will not necessarily be made in any year.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize to the value of Twenty-five Dollars, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year Student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the Annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest

standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. In any year in which no award is made, the income from the prize for that year will be available for a second award in any subsequent year.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available to students in this Department, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award will be made to another eligible student.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA MEDAL

The Royal Architectural Institute of Canada has presented a medal to be awarded annually to a member of the graduating class in the School of Architecture, who having completed the requirements for the degree, has obtained high standing throughout his course and gives promise of being an architect of distinction after graduation. The person to whom the award is made must be a British subject; he must have completed the entire course in Architecture in the School of Architecture of the University of Toronto, except in the case of a graduate of the Royal Military College who shall have completed at least the Third, Fourth and Fifth Years in the School; he must have obtained high standing throughout his course, particularly in Architectural Design, and his character, personality and intellect must be such as to indicate that in the practice of his profession, he may be expected to attain distinction. No award will be made in any Session in which the Council of the Faculty of Applied Science and Engineering so recommends.

RANSOM SCHOLARSHIP IN CHEMICAL ENGINEERING

The Ransom Scholarship in Chemical Engineering is presented by A. C. Ransom, Esq., of Toronto, for the purpose of encouraging and giving financial assistance to students who choose the field of Chemical Engineer-

ing. This donation, consisting of $5,000, provides for a perpetual scholarship of an annual amount such as will be derived from the income of this sum. The first award was made on the results of the annual examinations of 1938.

The scholarship will be awarded annually to the student registered in the Department of Chemical Engineering who obtains the highest aggregate percentage of marks in the examinations of the First Year. The scholarship will be paid to the winner only if he proceeds to take his Second Year in the Department of Chemical Engineering in the University of Toronto.

THE RHODES SCHOLARSHIP

The Rhodes Trustees offer two scholarships for award annually in the Province of Ontario, each of the value of £400 a year and tenable ordinarily for three years.

Each candidate must be a British subject with at least five years domicile in Canada, and unmarried; he must have passed his nineteenth but not his twenty-fifth birthday on October 1st of the year for which he is elected; and he must have reached such a stage in his course at the University that he will have completed at least two years.

In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments;
(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship;
(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his fellows;
(4) Physical vigour, as shown by fondness for and success in outdoor sports.

Forms of application and full information regarding these scholarships may be obtained from the University Registrar and E. W. Ireland, Esq., 372 Bay Street, Toronto 2, Secretary of the Committee of Selection for the Province of Ontario. Selection is made in December each year for the scholarships for the year following. Application must be made to the Secretary on or before November 10th.

UBUKATA FUND

The S. Ubukata Fund, the gift of the late S. Ubukata, of the value of $10,000, provides for the establishment of prizes, medals, scholarships and loans for which Japanese students of all faculties and colleges may be eligible. Application must be made to the University Registrar on or before December 1st.

F. W. JARVIS BURSARY

The F. W. Jarvis Bursary, the gift of A. H. Jarvis, Esq., of Ottawa, brother of F. W. Jarvis, of the value of $50, to be awarded under the following conditions:

1. The bursary is open only to former students of Ottawa Collegiate Institute (Lisgar Street), who without some such assistance may not be able to carry on their academic courses.
2. It may be awarded at matriculation or in any year of an undergraduate course in any faculty of the University.
3. It may be held in successive years by the same student and is tenable with any other scholarship awarded by the University or federated college.
4. It shall be awarded on the recommendation of a committee of award consisting of the President of the University, the Principal of Ottawa Collegiate Institute and the donor. Application must be made to the University Registrar on or before May 15th.

UNIVERSITY OF TORONTO WAR MEMORIAL SCHOLARSHIPS

Four scholarships, each of the value of Two Hundred and Fifty Dollars, have been established by the Alumni Federation of the University from the War Memorial Fund to be awarded to students in the Faculties of Applied Science and Engineering, and Forestry.

The general basis on which scholarships may be awarded shall be as follows: (*a*) standing in course of studies. (*b*) need of assistance. (*c*) merit as shown in extra-academic activities—executive, literary, dramatic, athletic, etc. (*d*) relationship, if any, to active service during the War.

Information regarding these scholarships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., to whom application must be made not later than April 15th.

UNIVERSITY OF TORONTO WAR MEMORIAL FELLOWSHIPS

Two Fellowships of the value of $500 each, in the School of Graduate Studies of the University have been established by the Alumni Federation of the University of Toronto from the War Memorial Fund, to be awarded to graduates of any approved university in the Dominion of Canada enrolled, or intending to enrol in the School of Graduate Studies, for the purpose of proceeding to a degree in any department of the University of Toronto.

The general basis of award is as follows: (*a*) standing at graduation or in previous year of postgraduate work. (*b*) such other general qualifications of merit as may commend themselves to the committee, including relationship (if any) to active service during the War.

Information regarding these fellowships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., to whom applications, accompanied by an official statement of undergraduate standing, should be made before March 1st.

McCHARLES PRIZE

This prize was established in connection with the bequest of the late Æneas McCharles of Provincial Government bonds of the value of $10,000, and is awarded on the following terms and conditions, namely, that the interest therefrom shall be given from time to time, but not necessarily every year, like the Nobel prizes in a small way: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions, as passed by the Board of Governors, determine the method of award:—

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000.00) in money.

(3) The term "Canadian" for the purpose of this award shall mean any person Canadian born who has not renounced British allegiance; and for the purpose of the award in the first of the three cases provided for by the bequest, domicile in Canada shall be an essential condition.

(4) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(5) No prize shall be awarded for any discovery or invention unless the same shall have been proved to the satisfaction of the awarding body, to possess the special practical merit indicated by the terms of the bequest.

(6) The order of priority in which the three cases stand in the wording of the bequest shall be observed in making the award; that is, the award shall go *caeteris paribus* to the inventor of methods of smelting Canadian ores; and, failing such inventions, to the inventor of methods for lessening the dangers attendant upon the use of electricity; and only in the third event, if no inventors of sufficient merit in the field of metallurgy and electricity present themselves, to the inventor distinguished in the general field of useful scientific research.

(7) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIP

The Royal Commissioners for the Exhibition of 1851 have invited the University of Toronto to recommend annually one or more candidates in order of merit for science research scholarships, each of the value of £275 per annum and ordinarily tenable for two years. The Commissioners may make a supplementary grant up to £30 per annum for University fees, etc., payable by the scholar during his tenure of the award.

Each candidate recommended must be a British subject, and under twenty-six years of age except in very special circumstances; he must have been a student of science in a university institution for a period of not less than three years and must have spent one full academic year at this University ending not more than twelve months prior to the date of recommendation.

The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

The scholar will be required to devote his whole time to research in some branch of pure or applied science at an institution in the United Kingdom or abroad, selected with the approval of the Commissioners.

The following are the departments of the University ,the students of which are eligible to apply for these scholarships:—1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geology; 13. Mineralogy; 14. Physics; 15. Physiology; 16. Zoology.

A student shall not be deemed to be ineligible because of his being on the staff of the University, if he has not been in receipt of a salary of more than $800 per annum and the nominating board may, at its discretion, recommend candidates who have been in receipt of larger salaries provided that all other conditions are fulfilled.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nominating board consists of the following members appointed by the Senate:—the Chancellor, the President, the Superior of St. Michael's College, Dean S. Beatty, Assistant Dean E. S. Ryerson, Dean C. H. Mitchell, Dr. C. S. MacInnes and Mr. N. F. Parkinson, and and the Board shall have power to call to its aid as assessor any member of the teaching staff.

Applications for these scholarships must be submitted not later than April 15th to the University Registrar from whom copies may be obtained of the general regulations of the Commissioners governing the award and tenure of the scholarship.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering to be known as The Nipissing Mining Company Research Fellowship, of the annual value of Eleven Hundred Dollars.

This Fellowship is open to the graduates of any University.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller of the class of 1893 the "Elizabeth Speller Memorial Fund" has been established, the annual income from which is available for loans to worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary.

THE T. H. BICKLE BURSARY

The T. H. Bickle Bursary is the gift of Mr. and Mrs. E. W. Bickle in memory of their son, T. H. Bickle, an undergraduate of Trinity College and a member of the Senior Intercollegiate Swimming Team at the time of his death in 1937. The income from the endowment of $1,000 will be awarded annually to a member of the Senior Intercollegiate Swimming Team of this University in any year or faculty. The Committee of Award shall consist of the Dean of the Faculty of Arts, the University Registrar, the Director of Athletics, and the Honorary Coach of Swimming. In awarding the Bursary the Committee shall consider the character, athletic ability, scholarship, and general interests of the members of the team.

SECTION XII. LIBRARIES AND LABORATORY EQUIPMENT

LIBRARIES

THE UNIVERSITY LIBRARY

The University Library building is situated on the east side of the lawn that lies to the south of University College. It contains reading-rooms for men and for women, a law reading-room, and a medical reading-room, besides departmental studies which may be used as study rooms for honour students in the various depratments in which the professors hold seminary courses, and private studies intended for advanced students engaged in research work.

The University Library building is opened at 8.45 every morning, and remains open until 10 o'clock in the evening, during the academic term. Books in ordinary use may not be taken out of the Library building or from the reserved book reading-rooms during the day-time, but are lent for the night toward 3 p.m., to be returned the following morning not later than 10 o'clock. Books not in general demand, may on application be borrowed for a longer period.

DEPARTMENTAL LIBRARIES

Periodicals and other literature in the University Library of special interest to the students of this faculty have been housed in the Electrical, Engineering, Mechanical and Mining Buildings for convenient reference.

These departmental libraries are situated as follows:

Applied Physics	Room 22, Engineering Bldg.
Architecture	Room 37, Engineering Bldg.
Chemical Engineering	Room 53½ Mining Bldg.
Civil Engineering	Room 25, Electrical Bldg.
	Room 22, Engineering Bldg.
Electrical Engineering	Room 25, Electrical Bldg.
Mechanical Engineering	Room 17, Mechanical Bldg.
Metallurgical Engineering	Room 37, Mining Bldg.
Mining Engineering	Room 314, Mill Bldg.

AERODYNAMIC LABORATORY

The Aerodynamic Laboratory is fully equipped with an improved 4-ft. Royal Aircraft Establishment type wind channel, aerodynamic balance, micromanometers and other necessary instruments.

Air speeds of 80 feet per second can be secured in a stream of great steadiness and uniformity and higher speeds with some sacrifice in steadiness.

The work done in the Laboratory includes the investigation of problems in aerodynamics, tests of air craft components, and complete machines, rating of meters, ventilators, radiators, etc., and the study of the effect of wind pressure on structures, chimneys, etc.

ASSAYING LABORATORIES

The Fire Assaying Laboratories are situated on the top floor of the new Mill Building. The East and West laboratories are identical and consist of preparation, furnace and balance rooms. Between and common to these is a supply room and another for the wet work in connection with the subject. The arrangement is such as to allow a natural flow of operations from preparation of the product to be assayed to the final weighing.

The preparation rooms are equipped with a Sturtevant crusher, McCool pulverizer, buck boards, samplers, cupel machines and screens. A special laboratory sampler has been constructed, for the purpose of giving samples for the students' assays, of indisputable similarity, thus confining variations in results to their work.

The furnace rooms have six Fletcher-Russell Perfected gas furnaces supported on concrete pouring tables, and two Denver Fire Clay oil-burning type. Each working table has its own balance, also a locker and drawers for fluxes, weights and tools.

The balance rooms face the north light. Protection from dust and fumes is afforded by double entrance doors. The bead balances are supported on a concrete slab resting on brick piers insulated by cork to absorb vibration. The balances are illustrative of the types met in practice, the following makers being represented—Ainsworth, Becker, Heusser, Keller, Oertling, Thompson and Voland. Some have a sensitivity of $\frac{1}{500}$ milligram.

Realizing the importance of storing fluxes, free from contamination, these are kept in an inner storeroom off the main supply room which houses clayware, and general stores. Remote from here is the ore storage room containing a large number of ores, matte, bullion and alloys, obtained chiefly from typical mining districts and metallurgical plants.

Undergraduate research is carried on in the Thesis room. This has coal and gas furnaces. Other apparatus is supplied to suit the investigations undertaken. A study room is always available.

Contiguous to the staff rooms are two equipped for research and the determinations required for instructional purposes. A Hoskins electric resistance furnace is installed, also a Leeds-Northrup controller and recorder. Other equipment includes optical, resistance and thermocouple pyrometers, microscopes, drying oven, Guess-Haultain stationary electrolytic outfit, King rotating electrolytic apparatus, and bullion rolls.

CEMENT TESTING LABORATORY

This laboratory is fitted with all the ordinary moulds, sieves, balances, burettes, steaming and drying tanks, tables, and other appliances necessary in making the usual physical tests of a Portland cement. It is also supplied with completely equipped cabinets for individual work. In addition there are the following:

A 2,000 lb. Riehlé shot machine for tension.

A 2,000 lb. Fairbanks shot machine for tension.

A 1,000 lb. Olsen automatic shot machine fitted for tests in either tension or cross breaking.

An Olsen soapstone moist closet.

CHEMICAL LABORATORIES

The Chemical Laboratories are situated in the western half of the Chemistry and Mining building, in the basement, first and second floors. The rooms are large and well lighted, and are supplied with the usual modern equipment.

Instruction in general chemistry and in elementary quantitative analysis is given in a large laboratory on the second floor, accommodating 84 students, each working place being supplied with water, gas and fume cupboard. Two adjoining laboratories, with provision for 50 students, are set aside for the use of the Second Year in the course in Chemical Engineering, while two other laboratories, with 36 and 48 working places, are used jointly by the Third Year in Chemical Engineering and by other students in Mining and Metallurgy, and also by the Department of Chemistry, Faculty of Arts. Fourth Year students in Chemical Engineering are accommodated in a laboratory which has provision for 20 men engaged in research work. Each of these laboratories has its own balance room adjoining, furnished with instruments from the best makers and adapted to the particular objects in view.

In addition there are seven small rooms set apart for research, a room for gas analysis and a specially constructed fireproof laboratory for combustion and bomb furnaces. Each of these is well equipped and offers excellent facilities for the prosecution of research, as well as for work of a technical character.

ELECTRICAL LABORATORIES

The Department of Electrical Engineering is located in the Electrical Building. The accommodation includes quarters for staff, library, lecture rooms, laboratories, stores, and shop for repairs and construction.

Services.—Three-wire direct-current, 110 kw., from the University power house, automatically regulated at our end for constant voltage of desired value at our main switchboard. Three-phase, 60 cycles, 60 k.v.a., 115 volts, automatically regulated as to voltage and frequency. Three-

phase, 25 cycles, 30 k.v.a., automatically regulated as to voltage and frequency. Every laboratory has all three services available at convenient places. There are three main boards, one for each floor. A system of special trunk lines between boards, and tree systems on each floor, enable easy arrangement of any desired special connections from any laboratory to any other.

Alternating Current Laboratory.—Area 26 x 110 ft., service sets 60 and 25 cycles, Tirrill regulators. Two 60-cycle and two 25-cycle, 15 k.v.a. motor-generator sets; converters: various motors, squirrel cage and wound rotor induction types, repulsion and other single-phase types, unity power factor motor, polyphase motor with variable speed shunt characteristics and speed range of 4 to 1; transformers, single and three-phase; constant-current transformers with load of series arc lamps; lamp racks, reactors, condensers, brakes, etc.; oscillographs; indicating, graphic, recording, and demand meters of the best makes; all arranged to facilitate a very general line of experimental work.

Direct Current Laboratory.—40 kw. 230 to 115 volt motor generator set with Tirrill regulator for special tests. Numerous 5 kw. to 10 kw. motor-generator sets; shunt, series, compound motors; special interpole machines; loading racks, dynamometers, rheostats, numerous meters of first quality, etc., for any sort of study.

Measurements Laboratory.—26 x 110 ft. Fitted with very flexible storage battery service which can be connected to any desired working place; d.c. three-wire service, also 60 and 25-cycle three-phase everywhere; galvanometers, resistance boxes, bridges, shunts, potentiometers, standard cells, bond testers, ductor, megger, apparatus for measuring low resistances, artificial lines for fault measurements, condensers, inductances, rails, cables, voltmeters, ammeters, wattmeters, dynamometers, etc., for general work on a great variety of measurements.

High Voltage Laboratory.—For various lines of study with voltages up to 200,000 volts. Flexible and safe provision for control.

Communication Laboratory.—Equipment for setting up and measuring vacuum tube circuits of all usual types. Equipment for measuring the properties of networks at both high and low frequencies. Cathode ray oscillographs and harmonic analyzers, amplifiers for bridge balance, etc. A one-thousand-cycle supply of good wave form is available at all measuring points in the laboratory. A room with necessary reproducing equipment is suitably sound-treated for hearing reproduced music.

Standardizing Laboratories.—One students' calibration room for direct-current meters, another for alternating-current meters. A standards room, constant temperature, for master standards of voltage, resistance, current, power, etc.

Research Laboratories.—Four rooms set apart for this work, in combination with facilities of the other laboratories.

Design Laboratory.—Arranged for calculation work on apparatus selected to illustrate essential principles.

ELECTROCHEMICAL LABORATORIES

The Electrochemical laboratories, which are situated in the Mining Building, are provided with special facilities for electrolytic work, including a large storage battery and electroplating dynamo with tanks as well as a good set of apparatus and electrical measuring instruments. The experimental work on electric furnaces is carried out in a large furnace room in the basement, occupied jointly by this Department and the Department of Metallurgy. The equipment for this purpose comprises a 120 KW, 220 volt supply of direct current from the main power house through a switchboard, rheostats, circuit-breaker and instruments to a set of distributing bus-bars, and a 200 KV-a transformer stepping down from 2200 volts to 30-120 volts in 3 and 6 volt steps, which supplies alternating current at 25 cycles. There is a complete set of A.C. instruments, circuit-breakers, oil-switches, relays, automatic regulating winches, etc., and a Northrup high frequency furnace with its transformer is also installed.

APPLIED PHYSICS LABORATORIES

The Applied Physics laboratories, situated in the Engineering Building, are equipped as follows:

The Photometric Laboratory is equipped with precision and portable photometers for the measurement of candle-power, illumination, and brightness, integrating spheres for determining the luminous output and efficiency of lamps and lunmiaires, and colorimeters, spectro-photometers and flicker photometers for the measurement of colour. Standards of candle power, luminous flux and colour temperature are maintained and a 132 volt storage battery with all electrical controls and meters necessary for precise photometry are provided.

The Illumination Design Laboratory is equipped for demonstrating and measuring the performance of lighting installations.

The Optics Laboratory is equipped with optical benches, etc., for the testing of lenses and examples of various optical instruments for instruction in their theory and applications.

The Photographic Laboratory is equipped with cameras, darkrooms and accessories for practical work in photography, and with sensitometers, spectrographs and densitometers for the testing of photographic materials. A Zeiss phototheodolite, stereoscope, stereo-comparator and plotting apparatus are provided for instruction in photographic surveying.

The Acoustical Laboratory is equipped with the ordinary apparatus for illustrating the elementary laws of acoustics, that is, forks, pipes, conometers, etc. There are also two rooms intended for work in sound transmission and absorption. The equipment of these consists of a four octave organ for the production of sounds of constant intensity and a microphone and amplifier circuit for reception. There is also an oscillator and dynamic loud apeaker as an alternative to the organ.

The Heat and Hydrostatics Laboratory is equipped for experiments on thermometry, calorimetry, thermal expansion, heat transmission, etc., and for work with hydrometers, manometers, barometers and the determination of specific gravity.

GEOLOGICAL AND MINERALOGICAL LABORATORIES

In the Mining building on College Street the University possesses a modern laboratory for Geology and Mineralogy.

Courses are given in laboratory work, especially in personal examination of type sets of rocks, fossils, minerals and crystal models. These laboratory exercises serve to illustrate the introductory didactic instruction.

For the encouragement of pure crystallography the laboratories are supplied with goniometers of the various types, crystal models, appliances for the cutting of oriented crystal sections and for the physical examination of the same. Practical petrography is carried on in rooms provided with type sets of rocks, both macroscopic and microscopic. Advanced students are taught to make thin sections of rocks and fossils and to study them microscopically. For students in Mining a laboratory course in the interpretation of geological maps and sections is provided. Typical mining regions are studied in detail and an opportunity is afforded for the examination of specimens illustrating economic geology.

The laboratory for the preparation of thin sections of rocks, minerals and fossils is provided with electric diamond saws and grinding appliances for the various types of work incidental to the preparation of thin sections and museum material.

A room is also provided for advanced work in cartography and geological surveying.

The departments possess 40 petrological microscopes and 10 of other types, so that it is now possible to provide advanced students with instruments and sets of thin sections for their own special use. The blowpipe laboratory contains 156 lockers, especially designed for apparatus for students. Provision is made for the study of opaque minerals in reflected light.

HIGHWAY LABORATORY

ROAD METALS AND SUBGRADE SOILS

This laboratory is equipped for carrying out investigations in the various materials employed in highway construction and maintenance, and comprises the following:

A Page impact machine for testing the toughness of road materials.

A diamond core drill for preparing specimens for the toughness test.

A Deval abrasion machine for testing the resistance to wear of road materials.

A cementation testing apparatus (Page type) for determining cement in properties of road materials.

A jaw crusher (Mitchell type) for crushing rock for various tests.

A power driven agitator with sieves for the mechanical analysis of sand, gravel and crushed rock.

A Dorry hardness testing machine for determining the hardness of rock used in road construction.

A Riehlé standard brick-rattler.

A mechanical centrifuge for determining moisture equivalent of soils and apparatus for determining volumetric changes, capillary moisture and other properties of subsoils of interest to the highway engineer.

A Hamilton Beach dispersing machine and a Bouyoucos hydrometer for determining soil analysis.

BITUMENS

This laboratory is designed for the investigation of the physical rather than the chemical properties of bitumens used in road construction and maintenance. The equipment consists of an extractor for separating bitumens and aggregates, an Engler viscosimeter, a penetration apparatus as well as appliances for determining melting point, volatilization, specific gravity, ductility, etc,

HYDRAULIC LABORATORY

The hydraulic laboratory occupies two floors each 40 feet x 112 feet, which are well lighted by large windows on the side and end.

The water for the experimental work is pumped through the various pieces of apparatus from a well by means of two turbine pumping units, both of which are driven by a Belliss and Morcom compound engine of 125 h.p. running at a speed of 525 revs. per minute. Both engine and pumps have been installed with a view to using them in experimental work as well as for supply of water for other apparatus used in the laboratory.

The pumping units are capable of delivering one cubic foot of water per second against heads of 250 feet and 300 feet respectively. These units are designed and connected up so that they may be run in series giving the above discharge at 550 feet head, or they may be run in parallel giving double the discharge at a lower head. Each pumping unit consists of two two-stage pumps mounted on a common base and driven by a single pulley, and the construction and piping are such that each two-stage pump may be driven separately or that all may be driven at once, discharging separately one cubic foot per second at about 125 feet head through each of four independent pipes, or else the pumps may be run in series or in parallel. The scheme is thus well adapted to laboratory work, and under the heads used on reaction turbines about six cubic feet per second may be obtained.

In addition to this there is an electrically driven pump capable of delivering six cubic feet per second at a head of sixty-five feet and which is most helpful in turbine testing. Attention is called to the special turbine testing flume described below.

The laboratory further contains a large vertical steel tank 5½ feet diameter by 34 feet, with arrangements for the attachment of nozzles and other mouthpieces, etc. Connections are also arranged for reaction turbines, the tank acting as a reservoir.

The discharge from the turbines or nozzles is measured in a weir tank nearly 6 feet wide and 21 feet long, containing a contracted weir 4½ feet wide. This weir may be calibrated by two weighing tanks, each having a capacity of about 240 cubic feet.

There are three reaction turbines and two impulse wheels all ready for experiment, the power being measured by brakes and the water by weir or orifices. Amongst the reaction turbines may be mentioned the one designed and built by Escher Wyss & Co., specially for the laboratory.

A new and specially designed turbine testing flume has recently been added to the laboratory, the machinery for which has been largely furnished through the kindness of the Dominion Engineering Works, Montreal, and Wm. Cramp and Sons, Philadelphia. This flume is supplied with water by a Moody spiral pump of twelve cubic feet per second capacity and at present there are two turbines, one of the propeller type, and also two special draft tubes and more will be added. This provides an excellent opportunity for experiment and research.

A Kaplan turbine has also been installed.

Smaller orifice and weir tanks, each about 3 x 3 x 12 feet with necessary measuring tanks, are arranged for instruction in coefficients of various kinds and practice with weirs and orifices.

A Venturi meter and other meters, also an hydraulic ram and similar devices are available for testing, and good facilities have been arranged for investigating friction and other properties of pipes and fire hose.

For special investigations on turbine and centrifugal pumps, other pumps in addition to those already described have been arranged.

The basement of the laboratory contains an open trough 5 feet wide, about 110 feet long, with a large weir at one end. It is intended to use this trough for experiments on the flow in open channels, for measurements of large discharges by means of the weir, and for experiments with current meters and Pilot tubes.

Numerous pieces of smaller apparatus, together with all instruments required, have also been provided, and the laboratory equipment is believed to be very complete. A glass trough 30 feet long has been added to the equipment.

MECHANICS OF MATERIALS LABORATORY

This laboratory is available for the scientific and commercial testing of materials of construction such as iron, steel, timber, concrete and masonry.

It is supplied with the following:

A 200 ton, three-screw power testing machine, built by Riehlé Bros., Philadelphia. It will make tests in tension, compression, shear and cross-bending, and will take posts 10 feet long and beams of 16 feet in span.

A Riehlé 100 ton screw power universal testing machine, taking posts 12 feet long and beams of 18 ft. span.

A Riehlé 10-ton screw power universal testing machine.

A Riehlé 50-ton screw power universal testing machine.

A 15-ton single lever-machine, built by J. Buckton & Co., Leeds, England.

A torsion machine, built by Tinius Olsen & Co., Philadelphia, for testing the strength and elasticity of shafting. This machine will accommodate specimens up to 16 feet in length and 2 inches in diameter.

A hand power torsion machine of simple mechanical design for the testing of short shafts of a maximum diameter of one inch.

A Riehlé transverse testing machine of 5,000 pounds capacity, adapted to specimens up to 48 inches in length.

A Riehlé compressometer, with spherical seat attachment for the adjustment of specimens having slightly non-parallel faces. This compressometer will receive specimens up to 10 inches in length.

A set of Riehlé proving levers with standard weights for calibrating testing machines.

An Amsler calibrating box of 60,000 lb. capacity for calibrating testing machines.

An Olsen compression micrometer of standard type.

A 20,000 pound Olsen, hand power, wire testing machine, specially fitted for testing wooden columns with both fixed and pivoted ends.

An Olsen combined tension and cantilever type impact testing machine.

An Olsen, 20,000 pound, hand-power testing machine especially adapted for testing long columns.

An Olsen, 200 pound capacity, textile testing machine.

A Berry strain-gauge for spans of 2 inches and 8 inches and an Olsen strain gauge of the same range.

A Nalder dividing engine. This may be used either for the precise division of scales or for the calibration of instruments intended for refined measurements.

A Brinell hardness testing machine.

An Olsen Brinell proving ring, 3,000 kg. capacity, for checking the Brinell hardness tester.

A Firth hardometer with diamond and ball attachments for hardness testing.

A Shore scleroscope for testing hardness.

A Fereday-Palmer stress recorder by T. Cooke & Sons, Ltd., London.

Four Beggs deformeter gauges with necessary plugs and accessories for investigating stresses in structures by means of models.

A large number of extensometers of the usual degree of precision. These include the Bauschinger, Martens, Unwin, Ames, Riehlé, Johnson, Henning

(recording), Huggenberger and other types. In addition there are the usual scales, micrometers, telescopes and reflectors, voltmeters for the determination of metallic contact, and such other appliances as are necessary in the making of precise measurements.

The shop is equipped with a number of high-class machine tools specially fitted for reducing the specimens to the requisite shapes and dimensions with a minimum of hand labour. It is also supplied with the necessary appliances for making ordinary repairs and for making apparatus for special experiment and original investigation.

METALLURGICAL LABORATORIES

This laboratory, in the East end of the Mining Building, occupies about 3,600 sq. ft. on the basement floor and the same space immediately above on the ground floor. The basement floor is divided into one large furnace room, a small hydrometallurgical room and two store-rooms. The furnace room contains a motor driven Connersville blower, several gas fired furnaces, two small blast furnaces, and a small 6 hearth Wedge roasting furnace. The larger electric furnaces of the Department of Electrochemistry are in this room. Some are supplied with direct current, others with A.C. from a 200 K.V.A. transformer. A system of flues, with hoods over all the furnaces, leads through a Cottrell precipitator of the Rathbun type taking current at 50,000 volts, to a stack through which gases are pulled by a fan in the attic.

The hydro-metallurgical room in addition to apparatus for leaching tests contains several natural draft furnaces, a large Hoskins resistance furnace and a 113 lb. drop hammer. There are also tanks for electrolytic refining and precipitation of metals.

The upper floor is divided into laboratories, store rooms and offices. The laboratories are: 1. Metallurgical analysis; 2. Heating treatment and pyrometry; 3. Grinding, polishing and etching; 4. Metallographic room with an adjoining dark room.

In the laboratory for metallurgical analysis the student is given some training in mill and smelter methods of analysis. It is well equipped for this work.

In the heat treatment and pyrometry laboratory are a number of tube furnaces of different sizes, a Leeds & Northrup transformation point indicator with furnace, double thermocouple and twin galvanometer, a Leeds & Northrup potentiometer pyrometer, a disappearing filament pyrometer, and many thermocouples for use with galvanometer or potentiometer. For grinding and polishing there is provided two motor driven emery wheels and a set of 3 motor driven horizontal polishing plates.

The Metallographic room is equipped with the lastest type Bausch & Lomb horizontal inverted microscope type of photo micrographic apparatus, an older and horizontal photo micrographic instrument made by Pellin, Paris; two vertical photo micrographic instruments and three other metallographic microscopes.

There are also a Pellin instrument for the determination of critical points by photography according to the Saladin method, and a Leeds & Northrup type "K" precision potentiometer, which is also used for the determination of critical points.

The laboratory has a Rockwell hardness testing machine, and a wire drawing bench.

The Ceramic equipment includes:

A dry pan and a vertical pug mill.

A small dry press.

A plunger machine with tile and hollow ware dies.

An Abbé six jar ball mill.

A recuperative down draft clay testing furnace of brick construction.

An oil fired muffle decorating kiln.

A small Seger test furnace.

A high temperature oxygen acetylene furnace.

A high temperature electric muffle furnace with a temperature range up to 1700°C.

Standard screens, volumeters, elutriation apparatus driers and such sundries as are necessary for clay testing.

METROLOGICAL LABORATORY

The department of surveying and geodesy is provided with all the ordinary field instruments, such as transits, levels, compasses, micrometers, sextants, planimeters, plane tables, tapes, chains, etc., with which is carried on the instruction in practical field operations as detailed elsewhere.

A small laboratory is also established in the basement of the observatory described below, containing the necessary instruments for the refined measurements of geodetic surveying; as, a standard yard and metre, a Rogers 10-foot comparator, an invar base measuring apparatus, a Kater's pendulum with vacuum chamber, a level trier, micrometer microscopes, etc.

The geodetic observatory in connection with this department is used for the instruction of students of the Fourth Year in taking observations for time, latitude, longitude, and azimuth by the precise methods used in connection with a geodetic survey. It contains a 10-inch theodolite and zenith telescope by Troughton & Simms; an astronomical transit instrument and an 8-inch theodolite by Cooke; two electro-chronographs; a Howard astronomical clock; a Dent sideral clock; a Dent sideral break-circuit chronometer; a wireless receiving instrument; arithmometers, etc.

MINING AND ORE DRESSING LABORATORIES

During 1931 the building containing these laboratories was entirely rebuilt and greatly enlarged. The new building is 72 ft. x 100 ft., and is four storeys high with a basement under half of it. The top floor and part of the second are occupied by the assaying laboratories. The rest of the

building is given up to the ore dressing and mining laboratories, the commodious library and study rooms, lavatory and shower baths, rooms for the staff, two rooms for research in ore dressing, a model and map room and storerooms. The main ore dressing laboratory, 72 ft. x 53 ft. x 22 ft. high, is equipped with the old five stamp battery with amalgamation plates, Wilfley table, Deister Plato table, Deister slime table, an old-fashioned buddle and classifiers. Parallel with the stamp mill is a ball mill 30 in. x 24 in., which can be used alternatively with the stamps in connection with the concentrating tables. At one side of this main laboratory is apparatus representing the complete flow-sheet of a modern concentrator designed for continuous operation at the rate of 50 to 100 lbs. per hour. This plant consists of feeders, two rod mills and a ball mill each 18 in. x 12 in., with classifiers, two Wilfley tables, a Dorr type thickener, a six-cell Fahrenwald Sub A flotation unit, a conditioner, a small pilot Wilfley table, and a Genter thickener. Another laboratory, 70 ft. x 25 ft., is set aside for batch work and contains a variety of flotation machines, small ball and rod mills, apparatus for cyanide tests and for tests in magnetic concentration. Other rooms are set apart for hand screening, microscopes, balances, a chemical room and a room for roasting and other high temperature testing of ores in connection with ore dressing.

The crushing laboratory contains a Hatfield gyratory crusher, a set of rolls 16 in. x 12 in., a small Dodge crusher, two sets of miniature rolls, two disc grinders, and a dry screening machine of the Feraris type. Adjoining this room is a large room for practising sampling methods. The mining laboratory is equipped with an Ingersoll-Rand type E.R.-1 compressor and a variety of air drills representing the development of this machine, blocks of synthetic ore for practising sampling, forges for sharpening steel and moils, and shortly to be completed a laboratory for the study of ventilation problems, air conditioning, dust counts, etc. In the main basement are bins for the accommodation of a large variety of ores from the different mining districts.

MUSEUM

The Royal Ontario Museum, with exhibits in Archaeology, Geology, Mineralogy, Palaeontology and Zoology, is situated at the southwest corner of Bloor Street and Queen's Park.

Students of the University in all departments are recommended to avail themselves of the privileges of the Museum, which, although under separate control, is intimately connected with the work of the University.

The Museum is open on all week days from 10 a.m. to 5 p.m., and on Sundays from 2 p.m. to 5 p.m. The admission is free to the public on Tuesday, Thursday, Saturday and Sunday. On other days an admission fee of fifteen cents is charged.

By a resolution of the Board of Trustees all regular students of the University may be admitted free on all days of the week by presenting their card of registration.

ONTARIO BOARD OF HEALTH LABORATORY

Through the courtesy of the Secretary of the Provincial Board of Health for Ontario the facilities of the excellently equipped laboratory which the Board maintains at Stanley Park have, with certain conditions, been placed at the service of the University for the investigation of problems of interest to the sanitarian and the sanitary engineer. The equipment consists of various types of sewage sedimentation tank, sewage filter, sewage measuring devices, aerators, sterilizing appliances and a complete and representative plant intended for the filtration and sterilization of water by practically all known methods.

PHOTOGRAPHIC AND PROJECTION LABORATORIES

The Photographic Laboratory contains a supply of small cameras for the use of students, enlarging cameras, printers, blue printing machine and the necessary dark rooms.

This Department also carries on a photographic and projection service for all Faculties and Departments of the University. The equipment for this work consists of cameras for making photographs up to full plate size, enlargers, photo-micrographic apparatus, motion picture cameras for both gross and micro work, with the necessary developing and printing machines, a rotary blue print machine, a photostat, etc.

For projection service there is a motion picture projector and a number of projection lanterns for service in any University Building.

THERMODYNAMICS AND MECHANICAL LABORATORY

This laboratory is included in a large, well-equipped building for the accommodation of the steam, gas, mechanical and hydraulic equipment. A more complete description of the laboratories has been published elsewhere, so that the present description is only intended to give the main features.

The part of the building set apart for thermodynamics and other mechanical work is the ground floor of a room 60 ft. x 155 ft. This room is lighted entirely from the roof in a very perfect way. A part of the space 40 ft. wide running the entire length of 155 feet is served by a 3 ton travelling crane and contains the following equipment:

50 h.p. Brown engine with separate jackets on both heads and barrel of cylinder.

Two-stage Rand air compressor having compound steam cylinders, each fitted with Meyer cut-off gear. The low pressure air cylinder has Corliss inlet gear.

30 h.p. high-speed Leonard tandem compound engine with shaft governor.

15 h.p. high-speed McEwen engine.

40 h.p. Uniflow engine.

25 h.p. General Electric steam turbine.

Two 15 h.p. Leonard engines with different types of valves, which are used for valve setting.

Centrifugal air compressor.

There are also two surface condensers with air pumps so arranged that any engine in the laboratory may be made to exhaust into the atmosphere through an open heater or into one of the condensers, the change from one arrangement to the other being accomplished in a few minutes without the aid of valves.

The laboratory further contains:

A 3 ton York refrigerating machine with tanks.

An Amsler transmission dynamometer.

Apparatus for testing injectors and steam pumps.

Hot blast heating equipment.

Numerous other pieces of apparatus and instruments.

The work on internal combustion engines and producers is performed on the following:

14 h.p. National gas engine arranged for various compressions and points of ignition.

25 h.p. horizontal Diesel engine made by Ruston and Hornsby, specially arranged for testing.

25 h.p. Allen semi-Diesel engine.

25 h.p. tractor gasoline engine.

Six cylinder Chevrolet automobile engine.

200 h.p. Sprague electric dynamometer.

Various accessories to above machines.

Steam for the laboratory is supplied by two 50 h.p. and one 100 h.p. Babcock and Wilcox boilers, the latter having an internal superheater. These boilers are located in a separate boiler room. They are used for experimental work only and are fitted up for testing. The gases pass up through two independent chimneys, and these have been arranged so that the draft and other conditions in the chimney at any point of its height may be examined.

In smaller work-rooms off the main laboratory are placed belt and oil-testing machines, apparatus for testing the efficiency of gears and machines, and for experiments in the balancing of machinery.

SECTION XIII. DISCIPLINE

1. (a) There is vested in the Council of each federated university or college, and of each faculty, disciplinary jurisdiction over and entire responsibility or the conduct of their students in respect of all matters arising or occurring in or upon their respective buildings and grounds, including residences.

(b) Disciplinary jurisdiction in all other cases as respects all students is vested in the Caput.

(c) The Students' Administrative Council, in the discharge of all duties entrusted to it, will be suported in the due discharge of those duties by the disciplinary power of the Caput.

2. No student will be allowed to continue in attendance, whose presence is deemed by the Council of his college or faculty to be prejudicial to the interests of the University.

3. Students proceeding regularly to the degree are required to attend the courses of instruction and the examinations in all subjects prescribed for students of their respective standing, and no student will be permitted to remain in the University who persistently neglects academic work.

4. Unless special permission is granted by the Council of the faculty concerned, a student will not be permitted further registration in the University if, at the end of two sessions spent in the same year of the faculty in which he is registered, he has failed to obtain the standing necessary to qualify him for registration in the succeeding year of the faculty. An appeal from the decision of the Faculty Council may be made to the Senate.

5. All interference on the part of any student with the personal liberty of another by arresting him, or summoning him to appear before any tribunal of students, or otherwise subjecting him to any indignity or personal violence, is forbidden by the Caput and by the Councils of the colleges and faculties.

6. No initiation ceremony involving personal violence, personal indignity, interference with personal liberty, or destruction of property, may be held by the students of any college or faculty of the University, under the penalty of suspension or expulsion.

7. Any reception of the students of the first year in any college or faculty must be approved by the Council of that college or faculty, but such reception must not involve any infraction of the regulations of the two preceding paragraphs.

8. The organizing of a parade in the streets of the city, or the taking part in such parade without the permission of the authorities of the city on application of the Students' Administrative Council, will be regarded as a breach of discipline.

9. A student who is under suspension, or who has been expelled from a college or faculty or from the University, will not be admitted to the University buildings or grounds.

10. The constitution of every society or association of students in the Faculty of Applied Science and Engineering, and all amendments to any such constitution, must be submitted to and approved by the Council of the Faculty. All programmes of such societies or associations must, before publication, receive the sanction of the Council. Permission to invite any person not a member of a faculty of the University to preside at or address a meeting of any such society or association must be similarly obtained.

11. The name of the University is not to be used in connection with a publication of any kind without the permission of the Caput.

12. Students of any faculty or college on the premises of colleges or faculties other than those in which they are registered shall be subject to the regulations and penalties imposed by the administrative authorities of the premises concerned.

SECTION XIV. HART HOUSE

Hart House, the gift of the Massey Foundation, is so called in memory of Mr. Hart Massey. This House, which is for the use of men only, is far more than a students' club. In its widest interpretation it seeks to provide for all the activities in the undergraduate's life apart from the actual work in the lecture room.

Hart House contains under one roof a dining hall, common-rooms, library, debates room, music room, a small chapel together with rooms for the use of the Student Christian Movement, an art gallery, an arts and crafts room, photographic rooms, billiard room, gymnasia, swimming pool, running track, rifle range, and theatre.

The House is open from 8.00 a.m. to 11.00 p.m. daily and meals are served to students in the Great Hall. Members are entitled to full privileges of all rooms in the building between these hours and the use of the gymnasia, pool, showers and locker rooms until 6.30 p.m. each day except Saturday and Sunday, subject to the regulations of the Athletic Association. On Saturday the pool, together with the rest of the athletic wing, closes at 4.00 p.m.

The Warden is entrusted with the general supervision of the whole House, but the athletic wing is under the direct control of the Athletic Directorate. In great measure the care of the House and its welfare are entrusted to the students themselves. There are a number of committees, most of which consist of ten undergraduates, three senior members, and the Warden. The undergraduates on all these committees are elected annually by the undergraduate members of Hart House and the undergraduate secretaries of five of them (House, Library, Music, Art, and Debates) sit on the Board of Stewards which, together with certain appointed members, is the governing board of the House and directly responsible to the Board of Governors. Of this Board the Warden is ex-officio chairman. The Comptroller, the Assistant Comptroller, the Secretary, and the Assistant Secretary of Hart House are responsible for the administration.

All men undergraduates proceeding to a degree in the University are members of Hart House. The annual fee (September to May) is $12.00 if paid before November 15th; after that date the fee is $14.00. To prevent the use of the building by unauthorized persons every member should carry his registration card and show it on request. Any member wishing to introduce a guest should obtain a card from the Warden's office.

Occasional students are not ordinarily eligible for membership in Hart House, but may make application to the Warden's office for election by the Membership Committee.

Graduate students, graduates resident in Toronto, and out of town graduates are entitled to the full privileges of Hart House when they have been duly elected and have paid the annual fee.

HART HOUSE THEATRE

Hart House Theatre is a repertory theatre existing to promote the interests of dramatic art in the widest sense. Its performances are open to members of the University and to the general public. The theatre is operated by a Board of Syndics, who are responsible to the Governors of the University for its administration. It is the policy of the Syndics to permit the rental of the theatre by those recognized dramatic societies within and outside the University which are endeavouring to do serious work.

THE SOLDIERS' TOWER

To commemorate the sacrifice of those graduates and undergraduates of our University who gave their lives in the Great War (1914-1918), the graduates have erected the Soldiers' Tower. Situated at the South-west corner of Hart House, the Tower rises—a symbol of sacrifice—and with its screen forms a majestic link between Hart House and the old Main Building. Beneath the sheltering arches of the screen, the names of the six hundred and eighteen, to whom the memorial pays its proud and affectionate tribute, are cut deep in the stone. Above, in the belfry of the Tower, is a carillon that, as it chimes, weaves a fabric of memories for professors and students who take up the tasks laid down by those who fell.

SECTION XV. STUDENT ORGANIZATIONS

THE STUDENTS' ADMINISTRATIVE COUNCIL

The Students' Administrative Council, is composed of the President and Head of the recognized men and women student organizations in each of the colleges, faculties and departments of the University, as outlined in Article 4 of the Constitution. The Students' Administrative Council assumes responsibility of the publication of The Varsity, Torontonensis and the Students' Handbook. It represents the students at University functions and on public occasions; and receives and administers all funds accruing from Student Council fees, revenues from publications and such other funds as shall become the property of the Students' Administrative Council; and through its secretaries it organizes such inter-collegiate and University activities as may be of interest to the student body as a whole.

The University band and the symphony orchestra are organized and administered by the Students' Administrative Council. The sale of official University rings, pins, crests, etc., and orders for official blazers are also in the hands of the Council. In addition, the Council operates an employment bureau for men and women undergraduates for summer, Christmas, and part-time work. It operates a loan fund for men and women undergraduates in the final two years of their courses. Applications for loans must be made to the Students' Administrative Council's office in January of each year.

The annual fee paid by all undergraduates proceeding to a degree, provides for a year's subscription to "The Varsity" and entitles the student to a copy of "Torontonensis" upon graduation, and also to a copy of "The Students' Handbook" at the beginning of each Michaelmas term. The fee also covers administrative costs of the Students' Administrative Council.

UNIVERSITY OF TORONTO ATHLETIC ASSOCIATION

By the authority of the Board of Governors University athletics for men are under the control of the University of Toronto Athletic Association of which the executive body is the Athletic Directorate consisting of:

the President of the University,

two members of the faculty, appointed by the President,

two graduates, appointed by the Athletic Advisory Board,

the Medical Director, the Athletic Director and the Financial Secretary (*ex-officio*),

five undergraduates, elected annually, from the student body,

an undergraduate representative, appointed by the Men Student's Administrative Council.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with men's athletics, and no men's athletic event can be held in the University without its approval. It has full control and direction of the gymnasium, the swimming pool, the locker rooms, showers and other conveniences in connection with athletics in Hart House, the athletic fields, stadium and ice arena. The Directorate is empowered by the Board of Governors to make the necessary arrangements to effect the carrying out of the University regulations requiring Physical Training for men. The annual athletic fee, subject to certain limitations, provides for the opening of the gymnasium and swimming pool at nights, permits each student to attend home games of the University football and hockey teams, and offers other privileges such as skating at the outdoor rink and affiliation with golf, riding and ski-ing clubs, etc.

UNIVERSITY OF TORONTO WOMEN'S ATHLETIC ASSOCIATION

By the authority of the Board of Governors University athletics for women are under the control of the University of Toronto Women's Athletic Association of which the executive body is the Women's Athletic Directorate consisting of:

- the President of the University,
- two women members of the faculty, appointed by the President,
- two women graduates, elected by the Women's Athletic Advisory Board,
- the Medical Adviser for Women, the Physical Directress, and the Financial Secretary (*ex-officio*),
- five women undergraduates, elected annually.
- one woman undergraduate, appointed by the Students' Administrative Council.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with women's athletics, and no woman student may participate in any athletic event during the academic year without its permission. The Medical Adviser for Women and the Physical Directress are authorized to arrange for such Physical Training for women as is required by the University. The annual athletic fee, subject to certain limitations, permits each student to attend home games of the University football and hockey teams, and offers other privileges such as skating at the outdoor rink and affiliation with golf, riding and ski-ing clubs, etc.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

The objects of the Engineering Society as set forth in its constitution are:

(*a*) The encouragement of original research in Engineering,
(*b*) The preservation of the results of such research,
(*c*) The dissemination of these results among its members,

(*d*) The cultivation of a spirit of mutual assistance and co-operation among the members of the Society in the preparation for, and in the practice of, the profession of Engineering,

(*e*) To afford an official means of communication between the Student body and the Faculty Council, the University authorities, and the students of other Faculties.

For purposes of organization the Engineering Society consists of a federation of clubs named as follows:

(*a*) The Civil Club of the Engineering Society, composed of undergraduates in Civil Engineering,

(*b*) The Mining and Metallurgical Club of the Engineering Society, composed of the undergraduates in Mining and Metallurgical Engineering,

(*c*) The Mechanical Club of the Engineering Society, composed of the undergraduates in Mechanical Engineering,

(*d*) The Electrical Club of the Engineering Society, composed of the undergraduates in Electrical Engineering,

(*e*) The Architectural Club of the Engineering Society, composed of the undergraduates in Architecture,

(*f*) The Industrial Chemical Club of the Engineering Society, composed of the undergraduates in Chemical Engineering,

(*g*) The Faculty of Applied Science Debating Club, composed of all undergraduates of the Faculty of Applied Science and Engineering.

These Clubs devote themselves to subjects of special interest to their members. Each club holds meetings at regular intervals, when papers are read, and discussions take place in technical subjects.

The Society meets during the academic years (except in April), beginning with the third Monday in October. Addresses are given by prominent men on subjects of general interest.

The Society publishes an annual, called "Transactions", which contains the addresses given at the meetings and an account of the year's activities.

A Supply Department is conducted by the Society on a co-operative plan, through which instruments, draughting supplies, stationery, and other supplies, can be purchased.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

Affiliated with the Engineering Society is the Faculty of Applied Science Athletic Association.

The Athletic Association has full control over all athletic clubs using the name of the Faculty of Applied Science. The Executive Committee has power to suspend anyone from the privileges of membership in the Association for any breach of its regulations, and controls the finances of all athletic clubs in the aforesaid Faculty. The annual membership fee of this Association is two dollars.

No other moneys are collected for the support of athletics in the Faculty of Applied Science without the sanction of the Executive Committee.

STUDENT CHRISTIAN MOVEMENT

The Student Christian Movement in the University of Toronto is part of an international fellowship of students in the colleges and universities of the world.

It is a fellowship, based on the conviction that in Jesus Christ are found the supreme revelation of God and the means to the full realization of life. It seeks, through study, prayer, and practice, to understand and follow Jesus Christ and to unite in its fellowship all students who share its basic conviction as well as those who wish to test its truth.

Some of the means employed by the Movement in realizing its purpose are study groups, worship services, forum discussions, conferences, lectures and addresses by prominent religious leaders, and social service in the downtown district. It is not necessary to "join" in order to share in the programme of the Movement. Its activities are open to all.

Full information may be had from the S.C.M. executives in the various Colleges, or from the General Secretaries of the S.C.M.: Rev. W. C. Lockhart, Hart House and Miss D. B. Fleming, Household Science Building. The names of the executives will be found in the Students' Handbook.

CANADIAN OFFICERS TRAINING CORPS

The University of Toronto Contingent of the Canadian Officers Training Corps provides for university students, the opportunity of obtaining War Office certificates of qualification as officers in the Canadian Militia and other Empire forces. This, apart from graduation from R.M.C., is the only means by which such qualifications can be obtained without first being appointed a provisional officer in a Militia unit.

Students in the Faculty of Applied Science and Engineering may train and qualify in Artillery, Survey, Engineering, Signalling, and Infantry, thus obtaining practical instruction which is most closely allied with and complementary to their more academic University course.

Most of the officers of the Contingent are selected from undergraduate members of the Corps; and members holding certificates of qualification are eligible, if recommended, to attend summer camps of instruction in various branches of the Services. Numbers of our graduates, holding certificates of qualification, have obtained permanent commissions in the Royal Canadian Air Force, the Canadian Militia, Imperial Army, Indian Army, and Royal Air Force.

University credit in Physical Training (compulsory in the first two years of attendance) is granted to members of the Corps who complete the annual training in the Contingent.

The Contingent headquarters are at 184 College Street, and include armouries, members' reading room, library, and lecture rooms.

The Contingent Staff is:

Officer Commanding.............Lieut.-Col. H. H. Madill, V.D., m.s.c.
Second in Command............................Major W. S. Wilson
Adjutant...................................Capt. W. E. Carswell
Paymaster...............................Major T. A. Reed, E.D.
Quartermaster...............................Capt. E. G. Moogk
Medical Officer...........................Capt. D. L. MacLean
Chaplain..
Contingent Sergeant-Major.....S-M. W. Hunt, late Royal Welch Fusiliers
Company Commanders:
"A" Co...................................Capt. H. C. H. Miller
"B" Co.....................................Capt. H. G. Oborne
"C" Co. (Applied Science)..............Major M. B. Watson, m.s.c.
"D" Co ....Capt. F. R. Crocombe

SECTION XVI. LODGING AND BOARD

GENERAL

Accommodation is readily obtainable in numerous private boarding-houses within a short distance of the University, at a cost of from ten dollars a week upwards and board obtained separately at about seven dollars per week. A list of accredited boarding-houses is kept by the Secretary of the Students' Administrative Council in Hart House and students are recommended to consult him with reference to the selection of suitable accommodation.

RESIDENCE FOR MEN

Through the generosity of the late E. C. Whitney, Esq., Mrs. Whitney and friends, the University offers to approximately one hundred and fifty men the advantages of residential life within its own grounds. The Residence consists of three Houses: South, East and North.

The regular rates are $3.25 a week for a single room or half of a suite (two bedrooms and common study). For men holding matriculation or undergraduate scholarships, for first class honour men in the Faculty of Arts, and for honours men in the other faculties, the rates are $3.00 a week. An occupant entitled to the lower rate must, when paying his rent, submit to the Bursar the evidence that he has the required standing. A student of the Faculty of Arts requiring this evidence may obtain it in the form of a certificate from the University Registrar, Simcoe Hall; a student of any other Faculty may obtain it from the Secretary of his faculty.

Except under very special circumstances, occupants who withdraw at any time during the Michaelmas term will be required to pay the full rent for that term. Occupants who obtain permission to withdraw during the Easter term will be required to give two weeks' notice and to forfeit their deposits.

Applications for rooms must be submitted to the Secretary of the Residence Committee, Registrar's Office, Simcoe Hall. Forms for this purpose will be supplied on request. Each application must be accompanied by a deposit, of $5.00. This deposit will be returned if the applicant is not admitted, but will be forfeited by the applicant if notification, in writing, of his refusal to accept the room assigned is not received by the Secretary before September 15th. On request the deposit will be refunded in full at the end of the college year if the room key is returned and the room and furniture left in a satisfactory condition.

The University lays down three general rules designed to prevent hazing gambling, and the use of intoxicants.

A circular giving further information may be obtained from the Secretary of the Residence Committee.

SUMMARY OF STUDENTS IN ATTENDANCE

Session 1937-38

Year	Department 1	2	3	4	5	6	7	8	8a	9	Total
I	29	49	52	4	15	68	34	17	1	7	276
II	14	44	30	3	13	53	35	33	1	1	227
III	20	30	21	2	6	56	23	14	..	2	174
IV	4	32	25	6	6	40	23	12	..	..	148
V	..	..	..	8	..	..	..	..	..	..	8
	67	155	128	23	40	217	115	76	2	10	833

For graduate students, see p. 177

SECTION XVII. THE ENGINEERING ALUMNI ASSOCIATION

The University of Toronto Alumni Federation exists to continue those very valuable associations formed as an undergraduate and to do everything in its power to further the interest of the undergraduates, the graduates, the Faculties and Colleges, and the University as a whole. The organization of the Alumni follows very closely that of the University. There are seventeen associations, each drawing its membership from one of the Colleges, Faculties, or Departments of the University. To get full co-ordination and co-operation between these various associations, a Federation, known as the Alumni Federation of the University of Toronto, was formed some years ago.

The governing body of the Federation, the Board of Directors, is composed of an Honorary President, a President, a Vice-President, thirty-two directors, and a Secretary-Treasurer. The Secretary-Treasurer is a paid permanent member of the Federation. He is in charge of the office maintained at 43 St. George Street to look after the clerical work of the various Associations and the Federation, and to arrange for the publication of the University of Toronto Monthly. The thirty-four Directors are appointed or elected from the various Associations and their tenure of office is from one to three years. The President is elected for one year and may be a member of any one of the constituent Associations. The Vice-President is elected in the same manner and either President or Vice-President may come from the Alumni or Alumnae at large.

The governing body of the Engineering Alumni Association is known as the Council. It is composed of a President, Past President, three Vice-Presidents, Secretary, Treasurer, six councillors resident in the city, two out-of-town councillors, the six Engineering Alumni representatives on the University Senate, Federation representatives, and the President of the Engineering Society. The councillors are elected for a term of three years.

Much of the work of promoting the interests of the Faculty in general, graduate and undergraduate, is carried out through the regular committees of the Engineering Council. These are Executive, Membership, Publicity, Scholarship, Undergraduate Relations, Reunions, Engineering Education, Federation Affairs, and Award of Merit. From time to time special committees are also formed as occasion demands.

The Association is composed of all "School" graduates and all students who have proceeded as far as their Second Year in the Faculty before leaving for any reason. They are all members of the Association, whether paid-up or not, but are only members of the Federation when they have paid their annual fees. The fees at the present time are on a graduated scale. For the first year after leaving the "School" the fee is one dollar,

for the second year two dollars, and after that the regular fee is three dollars. The distribution of these fees may be of some interest. One dollar goes to the Association's general funds and the other two dollars to the Federation to cover the cost of the clerical work involved in the running of the Association, its share of the Federation expenses, and the cost of producing and distributing the University of Toronto Monthly, which is sent to every paid-up member for nine months of the year, from October to June.

APPENDIX. GRADUATE STUDIES

Graduates interested in pursuing courses for post-graduate degrees should send inquiries to the Secretary of the School of Graduate Studies.

AERONAUTICS

The University is equipped with a four-foot wind tunnel in a specially designed building; and, so far as the facilities permit, properly prepared graduates will be admitted for private study, or for a course leading to an advanced degree (M.A.Sc. or Ph.D.).

Graduates who wish to undertake this work should apply to the Committee Administering the Wind Tunnel; and, if they are candidates for an advanced degree, should also register with the Secretary of the School of Graduate Studies, in accordance with the conditions laid down in the Calendar of that School.

REGULATIONS FOR DEGREES

MASTER OF APPLIED SCIENCE, MASTER OF ARCHITECTURE

The regulations governing the Degrees of Master of Applied Science (M.A.Sc.) and Master of Architecture (M.Arch.) shall be determined as follows:

1*a*. A candidate for the degree of Master of Applied Science shall hold the degree of Bachelor of Applied Science of this University or a degree from some other University recognized as equivalent by the Council of the School of Graduate Studies.

1*b*. A candidate for the degree of Master of Architecture shall hold the degree of Bachelor of Architecture or the degree of Bachelor of Applied Science in Architecture of this University or a degree from some other University recognized as equivalent by the Council of the School of Graduate Studies.

2. He shall register with the Secretary of the School of Graduate Studies at the beginning of the academic year.

3. Not later than November 1, he shall submit to the Secretary for acceptance by the Council of the School of Graduate Studies the title of his proposed thesis as approved by the department concerned.

4. Not later than May 15, he shall present evidence to the Council of the School of Graduate Studies that he has spent not less than one academic year in the department concerned as a student enrolled in one of the following departments on a course of study approved by the department: Civil Engineering, Mining Engineering, Mechanical Engineering, Architecture, Chemical Engineering, Electrical Engineering, Metallurgical Engineering.

5. Not later than May 15, evidence that the candidate has satisfactorily met all the requirements of the department with regard to thesis and to such examinations as the department shall require, shall be forwarded to the Council of the School of Graduate Studies through the sub-committee administering the regulations governing the degrees of Master of Applied Science and Master of Architecture.

CIVIL ENGINEER, MINING ENGINEER, MECHANICAL ENGINEER, ELECTRICAL ENGINEER, CHEMICAL ENGINEER, METALLURGICAL ENGINEER

The regulations governing the Professional Degrees of Civil Engineer (C.E.), Mining Engineer (M.E.), Mechanical Engineer (M.E.), Electrical Engineer (E.E.), Chemical Engineer (Chem.E.), Metallurgical Engineer (Met.E.), shall be determined as follows:

1. A candidate for one of the said degrees shall hold the diploma of the School of Practical Science or of the Faculty of Applied Science and Engineering or the degree of Bachelor of Applied Science, or shall have spent not less than two years as a member of the teaching staff in this Faculty after having graduated in Engineering from another institution of recognized reputation.

2. He shall have spent at least three years after receiving the diploma or the degree in the actual practice of the branch of engineering wherein he is a candidate for a degree.

3. Intervals of non-employment, or of employment in other branches of engineering, shall not be included in the above three years. It shall not be necessary that the several periods requisite to make up the said three years be consecutive.

4. The candidate shall obtain from the Secretary of the School of Graduate Studies, the formal application form, which, properly filled out, accompanied by the designated evidence of professional experience and by the title and synopsis of the proposed thesis, shall be delivered to the Secretary not later than the first day of November.

The evidence of professional experience shall fully describe the kind and extent of all work undertaken by the candidate since the date of graduation up to the time of application, indicating clearly the degree of responsibility for such work. Certificates from present and past employers shall accompany the application. The names and addresses of not less than five engineers to whom the candidate is personally known and who have knowledge of his professional activities shall be submitted.

5. The application, and the subject of the thesis is subject to the approval of the Board of Examiners, who may satisfy themselves by oral or written examinations in regard to the candidate's experience and competence in engineering works.

6. The candidate after notification of the approval of the Board shall prepare an original engineering thesis in the branch in which he has applied for a degree. This thesis shall be on work in which the candidate has had

actual experience and shall preferably be on the design of engineering works or processes, and shall be accompanied by all necessary descriptions, details, drawings, bills of materials, specifications, and estimates. A thesis of a solely descriptive type will not be acceptable.

7. The thesis, with accompanying papers, described in clause 6, shall be sent to the Secretary not later than the first day of March.

8. The candidate may be required to present himself for examination in the months of March or April at such time as may be arranged by the examiners.

9. The thesis, drawings, and other papers submitted under clause 7 shall become the property of the University.

10. Nothing in this statute shall prevent any candidate from receiving more than one of the said degrees, provided he has the necessary qualifications for each degree. An interval of three years must elapse between the granting of any two degrees under this statute.

DOCTOR OF PHILOSOPHY

Graduates of the Faculty of Applied Science and Engineering may proceed to the degree of Doctor of Philosophy. Information as to the conditions to be met by candidates for this degree is to be found in the Calendar of the School of Graduate Studies, which may be obtained from the Registrar of the University. The degree is an academic degree, not a professional one, and the research work and courses leading to the degree are primarily concerned with the fundamentals and underlying principles of the sciences. In general, a candidate selects one major and two minor subjects for study, the research being carried out in the major subject. A period of three years is usually required for the fulfilment of the requirements for the degree. However, it should be understood that the degree is not granted for the passing of prescribed courses or for the performance of prescribed laboratory work for a period of three years. The laboratory research work must have led to results of a high order, constituting a real contribution to the science of the major subject, and the candidate must have attained a decided maturity of knowledge and outlook before he may present himself for final examination by the Committee of the School of Graduate Studies. A graduate proposing to proceed to this degree should consult, in the first instance, with the members of the staff in the department in which he proposes to take his major subject.

A list of major and minor options in the Department of Chemical Engineering and in the Department of Mechanical Engineering are to be found in the Calendar of the School of Graduate Studies.

HIGH SCHOOL ASSISTANTS' CERTIFICATES

The Department of Education of Ontario has agreed to accept the degree of Bachelor of Applied Science as fulfilling the academic requirement for admission to the course for a High School Assistants' certificate in the Ontario College of Education.

SPECIALISTS' CERTIFICATES

By an agreement between the University of Toronto and the Department of Education of Ontario, persons holding the degree of Bachelor of Applied Science may, by taking certain prescribed courses in the Faculty of Arts, complete the academic requirements for admission to the qualifying examination for specialist courses in (*a*) Mathematics and Physics and (*b*) Science, at the Ontario College of Education. Information regarding these prescribed courses may be obtained from a pamphlet issued by the Registrar of the University, from whom copies may be had on application. Each person who desires to complete these academic requirements should communicate directly with the Registrar in order that his case may be considered and his particular conditions defined.

The Department of Education has approved of the acceptance of the degree in Applied Science in the Department of Engineering Physics, with standing of at least 60% at the final examination, as covering the academic requirements for admission to the qualifying examination for the Specialists' course in Mathematics and Physics at the Ontario College of Education.

ONTARIO LAND SURVEYORS AND DOMINION LAND SURVEYORS

Examinations are held usually in February of each year, for the following:

Preliminary Dominion Land Surveyors
Leveller's Examination
Final Dominion Land Surveyors
Ontario Land Surveyors

Any student in this faculty is eligible for these examinations, but graduates in Civil and Mining Engineering are allowed a shortened apprenticeship before writing their final examinations. Full information respecting above examinations may be obtained from the staff in Surveying and Geodesy.

GRADUATES ENROLLED IN THE DEPARTMENTS OF THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Civil Engineering, Municipal and Structural	2
Mechanical Engineering	4
Chemical Engineering	8
Electrical Engineering	1
Total	15

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UNIVERSITY OF TORONTO

CALENDAR

FACULTY OF APPLIED SCIENCE AND ENGINEERING

1939-40

THE UNIVERSITY OF TORONTO PRESS
1939

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SECTION I. CALENDAR 1939-1940

MICHAELMAS TERM 1939

July 1 Sat...... Dominion Day. Buildings closed.
July 15 Sat...... Last day for receiving applications for Supplemental Examinations.
Aug. 12 Sat...... Students of the III Year, Depts. 1, 2, and 9, report at University Survey Camp.
Sept. 2 Sat. Students of the IV Year, Dept. 1, Astronomy Option, report at University Survey Camp.
Sept. 4 Mon.... Labour Day. Buildings closed.
Sept. 12 Tues.... Supplemental Examinations commence.
Sept. 21 Thur.... Special meeting of Faculty Council.
Sept. 25 Mon.... Registration in person of the I Year from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.
Students in Architecture of the II, III, and IV Years report at University Survey Camp.
Sept. 26 Tues.... Registration in person of the II and III Years (except Architecture) from 9.30 a.m. to 12.00 noon, and 1.30 p.m. to 4.30 p.m., Mining Building.
The Dean's Address to the I Year at 9.00 a.m. in Room 38, Engineering Building.
Preliminary instruction for the I Year in Room 38, Engineering Building.
Meeting of Faculty Council.
Sept. 27 Wed..... Lectures and Laboratory work commence for I, II, and III Years at 9.00 a.m.
Registration in person of the IV Year (except Architecture), and the V Year in Architecture, from 9.00 a.m. to 1.00 p.m. Work for these students commences at 2.00 p.m.
The opening address by the President to the students of all faculties at 4.15 p.m. in Convocation Hall.
Oct. 2 Mon.... Meeting of Faculty Council.
Oct. 4 Wed..... Registration in person of II, III, and IV Years in Architecture at the Faculty Office.
Oct. 7 Sat...... Stated meeting of the Caput to deal with requests as to social functions until November 15.
Oct. 10 Tues.... Meeting of Engineering Society.
Oct. 13 Fri...... Meeting of Senate.
Oct. 20 Fri...... Intercollegiate Track Meet. Neither lectures nor laboratory classes given after 1 p.m.

Oct. 23 Mon.... Meeting of Engineering Society.
Nov. 1 Wed.... Meeting of Faculty Council.
Nov. 8 Wed..... Meeting of Engineering Society.
Nov. 10 Fri...... Meeting of Senate.
Nov. 11 Sat...... Remembrance Day, Service at the Soldiers' Tower at 11.00 a.m. Neither lectures nor laboratory classes given from 10.40 a.m. to 11.20 a.m.
Nov. 23 Thur.... Meeting of Engineering Society.
Dec. 1 Fri...... Meeting of Faculty Council.
Dec. 8 Fri...... Meeting of Senate.
Meeting of Engineering Society.
Dec. 20 Wed..... Michaelmas Term ends at 5.00 p.m.
Dec. 25 Mon.... Buildings closed.

EASTER TERM 1940

Jan. 1 Mon.... Buildings closed.
Jan. 3 Wed..... Easter Term begins.
Mid-session Examinations commence.
Meeting of Faculty Council.
Jan. 8 Mon.... Meeting of Engineering Society.
Jan. 12 Fri. Meeting of Senate.
Jan. 23 Tues.... Meeting of Engineering Society.
Feb. 1 Thur.... Meeting of Faculty Council.
Feb. 7 Wed..... Meeting of Engineering Society.
Feb. 9 Fri...... Meeting of Senate.
Feb. 22 Thur.... Meeting of Engineering Society.
Mar. 1 Fri...... Meeting of Faculty Council.
Mar. 6 Wed. ... Meeting of Engineering Society (nominations).
Mar. 8 Fri...... Meeting of Senate.
Engineering Society Annual Elections.
Mar. 18 Mon. Engineering Society Annual General Meeting.
Mar. 22-25 Fri.-Mon.... Easter. Buildings closed.
Apr. 1 Mon.... Meeting of Faculty Council.
Apr. 3 Wed..... Easter Term ends at 5.00 p.m.
Apr. 10 Wed..... Annual Examinations commence.
Apr. 12 Fri...... Meeting of Senate.
May 1 Wed..... Meeting of Faculty Council.
May 10 Fri...... Meeting of Senate.
May 24 Fri...... Victoria Day. Buildings closed.
June 5 Wed..... Meeting of Senate.
June 6-7 Thur.-Fri.... University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

1938-1939

THE UNIVERSITY

President..THE HON. AND REV. H. J. CODY, M.A., D.D., LL.D., F.R.S.C.
Registrar..............................A. B. FENNELL, M.C., M.A.
Bursar......................................C. E. HIGGINBOTTOM
Librarian............................W. S. WALLACE, M.A., F.R.S.C.
Superintendent of Buildings and Grounds..........A. D. LEPAN, B.A.Sc.
Director of University Extension and Publicity..W. J. DUNLOP, B.A., B.PAED.
Warden of Hart House................J. B. BICKERSTETH, M.C., M.A.
Director of University Health Service................G. D. PORTER, M.B.
Medical Adviser for Women Students..MISS E. GORDON, B.A., M.B., Dr.P.H.
Manager of the University of Toronto Press............A. G. BURNS, B.A.

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean........C. H. MITCHELL, C.B., C.M.G., D.S.O., C.E., LL.D., D.Eng.
Secretary............................W. S. WILSON, B.A.Sc., M.E.I.C.

INQUIRIES

Inquiries about admission to the Faculty of Applied Science and Engineering should be sent to the Registrar of the University.

Communications relating to curriculum, instruction, and examinations, in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information about opportunities for graduates of this Faculty, reference may be made to a pamphlet issued by the Director of University Extension and Publicity entitled "Opportunities for Graduates of Applied Science and Engineering."

SECTION III. TEACHING STAFF

1938-1939

PROFESSORS

E. A. Allcut, M.Sc. (Birm.), M.E., M.I.Mech.E. — 48 Foxbar Rd.
Professor of Mechanical Engineering.

G. R. Anderson, M.A., A.M. (Har.), M.I.E.S., F.A.S.A. — 7 Rose Park Cr.
Professor Emeritus of Engineering Physics and Photography.

R. W. Angus, B.A.Sc., M.E., Hon. M.E.I.C., Fellow A.S.M.E.
Professor of Mechanical Engineering. — Mechanical Bldg.

E. G. R. Ardagh, B.A.Sc., F.C.I.C., F.R.S.C. — 80 Strathallan Blvd.
Professor of Applied Chemistry.

E. R. Arthur, M.A., B.Arch. (Liv.), A.R.I.B.A. — 20 Montclair Ave.
Professor of Architectural Design.

J. W. Bain, B.A.Sc., F.I.C., F.R.S.C. — 393 Brunswick Ave.
Professor of Chemical Engineering.

E. W. Banting, B.A.Sc. — 101 Farnham Ave.
Associate Professor of Civil Engineering: Surveying and Geodesy.

B. de F. Bayly, B.A.Sc. — 2 Douglas Cresc.
Assistant Professor of Electrical Engineering.

M. C. Boswell, B.A.Sc., M.A. (Har.), Ph.D., F.R.S.C. — Mining Bldg.
Professor of Organic Chemistry (in Chemical Engineering).

H. J. Burden, D.S.O., D.F.C., B.A.Sc., M.F.A. (Princ.)
Assistant Professor of Architecture. — 289 Oriole Parkway

J. R. Cockburn, M.C., V.D., B.A.Sc., M.E.I.C. — 100 Walmer Rd.
Professor of Descriptive Geometry.

S. R. Crerar, B.A.Sc., D.L.S. — 122 Grenadier Rd.
Associate Professor of Surveying.

W. B. Dunbar, B.A.Sc., A.M.E.I.C. — 241 Glebeholme Blvd.
Assistant Professor of Engineering Drawing.

F. C. Dyer, B.A.Sc., M.E.I.C. — 164 Colin Ave.
Professor of Ore Dressing.

G. A. Guess, M.A. (Qu.) — Oakville, Ont.
Professor of Metallurgical Engineering.

H. E. T. Haultain, C.E., M.E.I.C. — National Club
Professor Emeritus of Mining Engineering.

K. B. Jackson, B.A.Sc. — 362 Glengrove Ave. W.
Associate Professor of Applied Physics.

J. T. King, B.A.Sc. — 126 Manor Rd. E.
Professor of Assaying.

A. T. Laing, B.A.Sc. — 146 Balmoral Ave.
Associate Professor of Highway Engineering (retired).

R. F. LEGGET, M.Eng.(Liv.), Assoc. M.Inst.C.E., A.M.E.I.C.
Assistant Professor of Civil Engineering: Municipal and Structural. 244 Glenrose Ave.

T. R. LOUDON, B.A.Sc., M.E.I.C. 189 Sheldrake Blvd.
Professor of Applied Mechanics.

W. G. MCINTOSH, B.A.Sc. 105 Bedford Rd.
Associate Professor of Mechanical Engineering.

R. R. MCLAUGHLIN, M.A.Sc., M.A., Ph.D. 52 Rosedale Rd.
Assistant Professor of Chemical Engineering.

H. H. MADILL, V.D., B.A.Sc., F.R.A.I.C. 14 Strathallan Blvd.
Professor of Architecture.

J. W. MELSON, B.A.Sc. 69 Walmsley Blvd.
Associate Professor of Civil Engineering: Surveying and Geodesy.

R. J. MONTGOMERY, B.Sc., Cer.E. (Ohio) 7 Cottingham Rd.
Associate Professor of Ceramics.

C. F. MORRISON, B.E.(Sask.), M.Sc.(McG.), A.M.E.I.C., 29 Claxton Blvd.
Assistant Professor of Civil Engineering: Municipal and Structural.

J. A. NEWCOMBE, B.Sc. (London), A.R.S.M. 10 Bowmore Rd.
Associate Professor of Metallurgical Engineering.

H. W. PRICE, B.A.Sc. 40 Ava Rd.
Professor of Electrical Engineering.

T. R. ROSEBRUGH, M.A., D.Sc., F.R.S.C. 92 Walmer Rd.
Professor Emeritus of Electrical Engineering.

W. L. SAGAR, B.A.Sc., C.E., A.M.E.I.C. 38 Melrose Ave.
Assistant Professor of Civil Engineering: Municipal and Structural.

E. A. SMITH, M.A. (McM.) Mining Bldg.
Assistant Professor of Chemical Engineering.

V. G. SMITH, B.A.Sc. 49 Nealon Ave.
Associate Professor of Electrical Engineering.

W. J. SMITHER, B.A.Sc., M.E.I.C. 35 Wilberton Rd.
Associate Professor of Structural Engineering.

R. TAYLOR, B.A.Sc. 82 Glen Echo Rd.
Associate Professor of Mechanical Engineering.

J. E. TOOMER, B.Sc. (N. Carolina) 26 Edgar Ave.
Assistant Professor of Metallurgy.

G. F. TRACY, B.A.Sc., M.S. (M.I.T.), 460 St. Clements Ave.
Associate Professor of Electrical Engineering.

W. M. TREADGOLD, B.A. 13 Woodlawn Ave. E.
Professor of Civil Engineering: Surveying and Geodesy.

A. WARDELL, B.A.Sc. 124 Melrose Ave.
Assistant Professor of Engineering Drawing.

C. G. WILLIAMS, B.A.Sc. 417 Rosemary Rd.
Professor of Mining Engineering.

C. H. C. WRIGHT, B.A.Sc., M.R.A.I.C. 419 Markham St.
Professor Emeritus of Architecture.

W. J. T. WRIGHT, M.B.E., B.A.Sc. 126 Melrose Ave.
Associate Professor of Engineering Drawing.
C. R. YOUNG, B.A.Sc., C.E., M.E.I.C. 119 Glenayr Rd.
Professor of Civil Engineering: Municipal and Structural.
A. R. ZIMMER, B.A.Sc. 80 Pine Crest Rd.
Associate Professor of Electrical Engineering.

LECTURERS

A. E. BERRY, M.A.Sc., C.E., Ph.D. 235 Gainsborough Rd.
Special Lecturer in Municipal Engineering.
R. J. BROWN, B.A.Sc. 272 Beresford Ave.
Lecturer in Electrical Engineering.
W. E. CARSWELL, B.Arch. Apt. 231, 215 College St.
Lecturer in Architecture.
H. S. M. CARVER Lorne Park House, Lorne Park
Special Lecturer in Town Planning.
T. L. CROSSLEY, A.M.E.I.C. 28 Lonsdale Rd.
Special Lecturer in Pulp and Paper.
A. V. DELAPORTE, C.E. 5 Millerson Ave.
Special Lecturer in Sanitary Chemistry.
H. B. DUNINGTON-GRUBB 4 St. Thomas St.
Special Lecturer in Landscape Architecture.
R. R. GRANT, O.L.S., C.A. 58 Poplar Plains Rd.
Special Lecturer in Accountancy and Business.
G. H. HALLY, B.A.Sc. Aurora
Lecturer in Mechanical Engineering.
V. L. HENDERSON, B.A.Sc., A.M. (Mich.) 397 Glengrove Ave. W.
Lecturer in Applied Physics.
P. V. JERMYN, B.A.Sc., M.E.I.C. 109 Cluny Dr.
Lecturer in Engineering Drawing.
F. H. KIRKPATRICK, Ph.B. (Hiram) 157 Alexandra Blvd.
Special Lecturer in Public Speaking.
R. E. LAIDLAW, B.A.Sc., K.C. 11 Dewbourne Ave.
Special Lecturer in Engineering Law.
M. J. C. LAZIER, B.A.Sc. 184 Briar Hill Ave.
Lecturer in Applied Mechanics.
G. R. LORD, B.A.Sc., S.M. (M.I.T.) 40 Maxwell Ave.
Lecturer in Mechanical Engineering.
W. C. MACDONALD, M.A.Sc. 184 Glen Road
Lecturer in Chemical Engineering.
R. B. McIntyre, B.A.Sc., B.A. (Camb.) 309 Lauder Ave.
Lecturer in Applied Mechanics.
A. S. MATHERS, B.A.Sc., F.R.A.I.C., A.R.C.A. 110 Highbourne Rd.
Special Lecturer in Architecture.

J. E. REID, B.A.Sc. — 111 Castlewood Rd.
Lecturer in Electrical Engineering.
J. J. SPENCE, A.M.E.I.C. — 162 Glencairn Ave.
Lecturer in Engineering Drawing.
R. C. WIREN, B.A.Sc., M.E.I.C., M.A.S.M.E. — East House, U. of T.
Lecturer in Mechanical Engineering.
S. E. WOLFE, M.A.Sc. — 80 Rusholme Rd.
Lecturer in Mining Engineering.

INSTRUCTORS

G. P. BEAL, M.A.Sc. — 68 Lakeview Ave.
Instructor in Chemical Engineering.
J. G. BRECKENRIDGE, B.A.Sc., Ph.D. (Camb.) — 21 Cluny Ave.
Instructor in Chemical Engineering.
R. M. CLARK, B.A.Sc. — 44 Willcocks St.
Instructor in Engineering Drawing.
F. COATES, A.R.C.A. — Scarborough Bluffs
Instructor in Modelling.
G. R. EDWARDS, B.A.Sc. — 1263 King St. W.
Instructor in Engineering Drawing.
A. M. FITZGERALD, B.A.Sc. — 150 Summit Dr.
Instructor in Chemical Engineering.
C. W. JEFFERYS, R.C.A., O.S.A., LL.D.(Qu.) — 4111 Yonge St.,
Instructor in Painting. — York Mills, Ont.
L. E. JONES, B.Sc.(Man.), M.A.Sc. — Apt. F, 258 Wellesley St.
Instructor in Applied Physics.
MISS J. C. LAING, B.A. — 31 Cowan Ave.
Librarian, and Instructor in Architectural History and French.
L. S. LAUCHLAND, B.A.Sc. — North House, U. of T.
Instructor in Electrical Engineering.
T. L. ROWE — 104 Braemore Gardens
Instructor in Civil Engineering: Surveying and Geodesy.
MACKENZIE WATERS, M.C., V.D., B.A.Sc., F.R.A.I.C., A.R.C.A.
Special Instructor in Architectural Design. 267 Roxborough St. E.

DEMONSTRATORS

M. ADELMAN, B.A.Sc. — 63 Lowther Ave.
Demonstrator in Chemical Engineering.
R. G. ANTHES, B.A.Sc. — 182 Fulton Ave.
Demonstrator in Electrical Engineering.
R. J. BIRSS, B.A.Sc. — Brampton
Demonstrator in Mechanical Engineering.
C. J. BRIDGLAND, M.A.Sc. — 266 South Kingsway
Demonstrator in Electrical Engineering
J. A. C. BOWEN, B.A.Sc. — 70-36th St., Long Branch

J. M. CARSWELL, M.M., B.A.Sc. *Demonstrator in Engineering Drawing.*	7 Edgewood Gardens
E. L. DODINGTON, B.A.Sc. *Demonstrator in Applied Physics.*	Apt. 6, 446 Jarvis St.
C. A. ERNST, B.A.Sc. *Demonstrator in Mechanical Engineering.*	South House, U. of T.
F. G. EWENS, B.A.Sc. *Demonstrator in Mechanical Engineering.*	Apt. 3, 83 Madison Ave.
W. E. EWENS, B.A.Sc. *Demonstrator in Engineering Drawing.*	104 Dawlish Ave.
N. R. FASKEN, B.A.Sc. *Demonstrator in Chemical Engineering.*	Apt. 23E, 10 Tichester Rd.
A. S. FOREMAN, B.A.Sc. *Demonstrator in Mechanical Engineering.*	35 Spadina Rd.
W. M. FOSTER, B.Sc., (Qu.) *Demonstrator in Electrical Engineering.*	226 St. George St.
T. A. FRANKISH, B.A.Sc. *Demonstrator in Mining Engineering.*	617 Spadina Ave.
J. W. FRY, B.A.Sc. *Demonstrator in Mechanical Engineering.*	South House, U. of T.
C. W. GALBRAITH, B.Sc., (Man.) *Demonstrator in Electrical Engineering.*	141 Springhurst Ave.
D. H. HAMLY, M.A., Ph.D. *Demonstrator in Applied Physics.*	106 Keewatin Ave.
R. H. HAUBNER, B.Sc. (Man.) *Demonstrator in Electrical Engineering.*	297 St. George St.
C. E. HELWIG, M.A.Sc. *Demonstrator in Civil Engineering.*	61 Braemore Gardens
W. A. M. HEWER, B.A.Sc. *Demonstrator in Mining Engineering.*	72 St. Albans St.
G. T. HODGSON, B.A.Sc. *Demonstrator in Electrical Engineering.*	35 Lorindale Ave.
L. E. HOREMBALA, B.A.Sc. *Demonstrator in Chemical Engineering.*	722 Queen St. W.
R. H. JUNKER, B.A.Sc. *Demonstrator in Mining Engineering.*	Apt. 14, 340 Avenue Rd.
C. E. LINGREN, M.A.(Qu.) *Demonstrator in Engineering Drawing.*	55 Harbord St.
L. G. MACDOUGALL, B.A.Sc. *Demonstrator in Electrical Engineering.*	138 Bedford Rd.
B. MARKS, B.A.Sc. *Demonstrator in Chemical Engineering.*	2306 Bloor St. W.
W. A. MOHUN, B.A.Sc. *Demonstrator in Applied Physics.*	129 Spadina Rd.

W. E. B. PARKER, M.A.Sc. — 216 Deloraine Ave.
Demonstrator in Hydraulics.
W. H. RAPSON, M.A.Sc. — Apt. 40, 223 Woodbine Ave.
Demonstrator in Chemical Engineering.
E. A. RICKER, B.A.Sc. — 55 Harbord St.
Demonstrator in Electrical Engineering.
E. A. RUSSELL, B.A.Sc. — 111 Ranleigh Ave.
Demonstrator in Civil Engineering.
D. P. SCOTT, M.A.Sc. — 471 St. Clement's Ave.
Demonstrator in Engineering Drawing.
I. W. SMITH, B.A.Sc. — 102 Roxborough St. W.
Demonstrator in Mechanical Engineering.
L. W. SMITH, B.A.Sc. — 171 Glendonwynne Rd.
Demonstrator in Chemical Engineering.
J. B. TRELOAR, B.A.Sc. — 104 Lansdowne Ave.
Demonstrator in Mechanical Engineering.
W. T. TURRALL, M.A.Sc. — 2 Maplewood Ave.
Demonstrator in Mining Engineering.
W. A. WALLACE, B.A.Sc. — 74 Glendale Ave.
Demonstrator in Mechanical Engineering.
A. S. WEATHERBURN, B.A.Sc. — 38 Macpherson Ave.
Demonstrator in Chemical Engineering.

PROFESSORS OF OTHER FACULTIES GIVING INSTRUCTION TO STUDENTS IN APPLIED SCIENCE

F. C. AULD, B.A. (McG.), M.A., B.C.L. (Ox.) — 21 Poplar Plains Cres.
Professor of Roman Law and Jurisprudence and Special Lecturer in Commercial Law.
S. BEATTY, M.A., Ph.D., F.R.S.C. — 537 Markham St.
Professor of Mathematics.
H. BOESCHENSTEIN, Ph.D. (Rostock) — 103 Bedford Rd.
Assistant Professor of German.
R. BRAUER, Ph.D.(Berlin) — 91 Bernard Ave.
Assistant Professor of Mathematics.
J. D. BURK, B.A. — 30 Duggan Ave.
Assistant Professor of Mathematics.
J. T. BURT-GERRANS, Phm.B., M.A., Ph.D. — 46 Dewson St.
Professor of Electrochemistry.
E. F. BURTON, B.A. (Tor.), (Camb.), Ph.D., F.R.S.C.
Professor of Physics. — 224 Queen's Drive, Weston
J. B. FERGUSON, B.A., F.R.S.C. — 100 Albertus Ave.
Associate Professor of Chemistry.

L. GILCHRIST, M.A., Ph.D. (Chic.), F.R.S.C. *Professor of Physics.*	North House, U. of T.
T. HEDMAN, Ph.B. (Chic.) *Associate Professor of German.*	171 Old Forest Hill Rd.
F. B. KENRICK, M.A., Ph.D. (Leip.), F.R.S.C. *Professor of Chemistry.*	77 Lonsdale Rd.
G. B. LANGFORD, B.A.Sc., Ph.D. (Corn.) *Professor of Mining Geology.*	14 Wychwood Park
A. MACLEAN, B.A. *Professor of Geology.*	488 Spadina Ave.
E. S. MOORE, M.A., Ph.D. (Chic.), F.R.S.C. *Professor of Geology.*	18 Indian Grove
A. L. PARSONS, A.B. (N.Y.) *Professor of Mineralogy.*	15 Glencairn Ave.
I. R. POUNDER, M.A., Ph.D. (Chic.) *Professor of Mathematics.*	19 Glen Gordon Rd.
D. A. F. ROBINSON, M.A., Ph.D. (Chic.) *Associate Professor of Mathematics.*	592 University Ave.
L. J. ROGERS, B.A.Sc., M.A. *Professor of Chemistry.*	110 GarfieldAve.
J. SATTERLY, M.A. (Camb.), D.Sc. (Lond.), F.R.S.C. *Professor of Physics.*	95 Bernard Ave.
J. L. SYNGE, M.A., Sc.D. (Dub.), F.R.S.C. *Professor of Applied Mathematics.*	222 Rose Park Dr.
J. E. THOMSON, B.A.Sc., Ph.D. (Har.), F.R.S.C. *Professor of Mineralogy.*	123 Welland Ave.
A. M. WYNNE, M.A. (Qu.), Ph.D. *Associate Professor of Biochemistry.*	27 Lytton Blvd.

SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant-Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers, and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate, by statute subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909-1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910-1911. In the session 1923-1924 the Degree of B.Arch. was offered to students in Architecture.

SECTION V. ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

GENERAL

1. Candidates for admission to the Faculty of Applied Science and Engineering must submit evidence to show that they are qualified to take one of the courses of instruction and proceed to a degree. Applicants must also submit a certificate of good character, and must have completed the seventeenth year of their age. The procedure for application and registration is described in paragraph 8 below.

2. In general, the holding of any of the following classes of certificate will constitute qualification for admission to this Faculty.

(*a*) Certificates of Ontario Pass and Honour Matriculation as described in paragraph 3 below.

(*b*) Certificates of having passed certain equivalent examinations as described in paragraph 5 below.

(*c*) Certificates of undergraduate work in other universities. See admission ad eundem statum, paragraphs 6 and 7 below.

The Senate will consider applications for the recognition of certificates other than those mentioned as occasion may require. Such certificates must be accompanied by an official statement of the marks in the various subjects upon which the certificate was granted.

ONTARIO MATRICULATION

3. Certificates of Ontario Matriculation for admission to the Faculty of Applied Science and Engineering must cover complete Pass Matriculation, and five subjects of Honour Matriculation.

PASS MATRICULATION

Complete Pass Matriculation will consist of these subjects:

English (Literature and Composition),
History (Canadian and Ancient), or Canadian History and Music,
Mathematics (Algebra and Geometry),
And three of: Greek (Authors and Accidence),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition), or
Spanish (Authors and Composition),
Science (Physics or Agriculture Part I, and Chemistry or Agriculture Part II),
Arithmetic with Mechanical Drawing* and Shop Work.*

*Credit in Mechanical Drawing and Shop Work will consist of certificates from the Principal of the School, accompanied by an approving certificate from the Director of the Technical School Branch of the Department of Education for Ontario. This option applies to students—and to such students only—who have been in attendance at, and matriculate from, a Technical School in the Province of Ontario and are so certified by the Department of Education of the Province.

HONOUR MATRICULATION

Honour Matriculation will consist of these subjects:

English (Literature and Composition),
Algebra and Geometry,†
Trigonometry,†
Science (Physics and Chemistry),
And one of: Greek (Authors and Composition),
Latin (Authors and Composition),
German (Authors and Composition),
French (Authors and Composition),
Italian (Authors and Composition),
Spanish (Authors and Composition).

†Admission to the Department of Engineering Physics will be granted only to those who have met the regular requirements for admission to the Faculty of Applied Science and Engineering and, in addition, have obtained an average of 75 per cent. in the Mathematics (Algebra, Geometry, and Trigonometry) of the Honour Matriculation Examination. Students whose general proficiency record in other subjects is not correspondingly high are advised not to seek admission to the course.

4. Those intending to enter the course in Architecture are recommended to select French as one of the Matriculation subjects; those intending to enter Chemical, Civil, Electrical, or Mechanical Engineering or Engineering Physics are recommended to select German; while those intending to enter Metallurgical Engineering are advised to select Spanish.

EQUIVALENT EXAMINATIONS

5. Certificates of the following examinations recognized as equivalent in value to the Ontario Matriculation, Pass, or Honour, may be accepted in so far as they meet the Ontario requirements in subjects and percentages and conform to the admission requirements of the universities of the respective provinces. A candidate applying for admission on such certificates must submit an official statement of the marks upon which these certificates were awarded.

Province of Ontario

Middle School or Upper School examinations or examinations of the same standard under other names.

Province of Quebec

Quebec High School Leaving and Senior High School Leaving Examination Certificates; the Junior and Senior Matriculation examinations of McGill University.

Province of New Brunswick

Grammar School or First Class Licenses; also the Superior except for Latin.

Province of Nova Scotia

High School Certificates of Grade XI and Grade XII issued by the Department of Education.

Province of Manitoba

Grade XI and Grade XII examinations.

Province of British Columbia

Junior (Grade XII) and Senior (Grade XIII) Matriculation examinations.

Province of Prince Edward Island

First Class License Certificates issued either by the Education Department or Prince of Wales College; Third Year Certificates issued by the above College.

Province of Alberta

Grade XI and Grade XII examinations.

Province of Saskatchewan

Grade XI and Grade XII examinations.

Newfoundland and the Maritime Provinces

Certificate of the Common Examining Board, Junior and Senior Associate Diplomas of the Department of Education of Newfoundland.

Great Britain

Certificate of having passed, or having exemption from, the Preliminary Examination of the Institution of Civil Engineers in the British Isles, or equivalent.

ADMISSION AD EUNDEM STATUM

6. An undergraduate of another university may be admitted ad eundem statum on such conditions as the Senate, on the recommendation of the Council of the Faculty, may prescribe.

7. An applicant for admission ad eundem statum must submit with his application for admission: (1) an official transcript of his record in the University from which he wishes to transfer, showing in detail the courses which he has completed, with his standing in each; (2) certificate of honourable dismissal; (3) certificate of vaccination; (4) calendar of the university giving a full description of these courses.

PROCEDURE FOR APPLICATION AND REGISTRATION

8. Candidates for admission should apply to the Registrar of the University for forms of applications for admission; they are required to fill in these forms in duplicate and return them to the Registrar *not later than* September 10th, together with the following: (*a*) all Pass and Honour Matriculation or equivalent certificates which they may hold; (*b*) any other evidence of ability to take the work proposed; (*c*) certificate of good character; (*d*) certificate of vaccination. Failure to make early application will result in delay and inconvenience for the candidate.

9. By order of the Board of Governors, all candidates for admission must submit a certificate of successful vaccination with their application, or agree to submit such certificate within ten days after the opening of the session. The Directors of the University Health Services will arrange for the vaccination of those who so desire.

10. Every student must register in person with the Secretary of the Faculty as prescribed on page 5 of the Calendar.

11. A student who fails to register as prescribed in clause 10, must petition the Council for permission to register late. The Council, however, reserves the right to refuse the permission, or to impose a penalty, such penalty to be reckoned at one dollar per day, or part thereof, that elapses between the close of registration as prescribed and the filing of the petition.

12. A petition for permission to register late must be accompanied by a deposit equal to the estimated amount of the penalty. Should the Council decide that no penalty is to be imposed, the deposit will be refunded.

SECTION VI. FEES AND DEPOSITS

1. Every student in attendance proceeding to a Bachelor's Degree in the Faculty of Applied Science and Engineering is required to pay the following annual fees: Composite, Medical Examination and Physical Training, Hart House (women exempt), Students' Administrative Councils, Engineering Society, and Athletic Association (women exempt). These fees are described in detail below.

All fees due in the Michaelmas term must be paid in full on or before October 15th, and all fees due in the Easter term on or before January 15th; after these dates a deferred payment fee of one dollar a month will be imposed in each term until the whole amount is paid.

2. Special fees are required for matriculation, supplemental examinations, admission ad eundem statum, and degrees.

3. (a) *Students must have paid fees due in the first term before proceeding to the work of the second term. A student will not be admitted to any of the University lectures or laboratory classes who is in arrears for his fees.*

(b) *A student will not be allowed to write any examination if he has not paid all fees for which he is liable at that time.*

COMPOSITE

4. (*a*) The composite fee, payable to the Bursar of the University, including tuition, library, laboratory supplies (but not laboratory deposits), and one annual examination for each year, shall be as follows:

If paid in full on or before October 15th $250.00

If paid in instalments:—

First instalment, if paid on or before October 15th 125.00
Second instalment, if paid on or before January 15th 128.00

(*b*) A student who is repeating his year is required to pay the same fee as other students.

SUPPLEMENTAL EXAMINATION

5. Candidates for supplemental examinations are required to pay a fee to the Bursar not later than September 1st. The fee is $10.00 for either one or two supplemental examinations. For each supplemental examination in a laboratory subject requiring special supervision the fee is $20.00.

MATRICULATION, OR REGISTRATION OF MATRICULATION

6. Applicants for admission under paragraph 2, (*b*), (*c*), section V, are required to pay to the Bursar a fee of $5.00 for registration of matriculation.

ADMISSION AD EUNDEM STATUM

7. Applicants who are admitted ad eundem statum are required to pay to the Bursar a fee of $10.00.

DEGREES

8. Candidates for the degree of B.A.Sc. or B.Arch. are required to pay to the Bursar by January 15th of their year of graduation, a fee of $10.00.

MEDICAL EXAMINATION AND PHYSICAL TRAINING

9. Every man is required at the opening of each session in which Physical Training is compulsory for such student, to pay to the Bursar the annual fee of $5.00 for medical examination and such subsequent physical training as may be prescribed.

10. Every woman is required to pay a corresponding fee of $4.00.

HART HOUSE

11. Every man in attendance is required to pay to the Bursar on or before October 15th the annual fee of $12.00 for the maintenance of Hart House.

ATHLETIC FEE

12. Every student in attendance proceeding to a Bachelor's degree is required to pay to the Bursar on or before October 15th the annual Athletic fee of $3.00.

STUDENTS' ADMINISTRATIVE COUNCILS

13. Every student is required to pay to the Bursar at the time of registration the annual fee, as shown in the summary below, paragraph 17, for the maintenance of the Students' Administrative Councils.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

14. All students in attendance are required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Engineering Society.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

15. Each man in attendance is required to pay to the Faculty at the time of registration an annual fee of $2.00 for membership in the Athletic Association of the Faculty.

LABORATORY DEPOSIT

16. A laboratory breakage deposit, to be paid to the Faculty at the time of registration, is required from all students. The amount of the deposit is shown in the summary below. This deposit, less charges for waste, neglect, and breakages, will be refunded by the Secretary at the end of the session. Should the deposit be insufficient to meet the charges, a levy will be made to cover the deficiency.

17. SUMMARY OF FEES AND DEPOSITS

Composite in advance	$250.00 B
In instalments	253.00 B
Supplemental Examinations*	
Written or laboratory (one or two)	10.00 B
Laboratory requiring special supervision	20.00 B
Matriculation, or registration of Matriculation	5.00 B
Degrees (B.A.Sc., B.Arch.)	10.00 B
Medical Examination and Physical Training* (men)	5.00 B
Medical Examination and Physical Training* (women)	4.00 B
Hart House (women exempt)	12.00 B
Athletic Fee	3.00 B
Students' Administrative Councils,	
All Years except Graduating Year	2.00 B
Graduating Year	6.00 B
Engineering Society	2.00 F
Athletic Association (women exempt)	2.00 F
Laboratory Deposit, Civil, Mechanical, and Electrical Engineering, Architecture, and Engineering Physics	3.00 F
Mining, Chemical, and Metallurgical Engineering, and Mining Geology	8.00 F

Items marked "B" are payable at the office of the Bursar; items marked "F" are payable at the Faculty Office at the time of registration.

All cheques must be made payable to "University of Toronto."

*18. Every student who has neglected to complete satisfactorily the course in Physical Training of the First or Second Year, and who must take this work during a later year, will be required to pay to the Bursar at the opening of that session a supplemental fee of $10.00 in addition to the prescribed Medical Examination fee.

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating department or school in which he intends to proceed to a degree. There are eight departments in Engineering and the School of Architecture from which the selection may be made, viz.,

Civil Engineering (Dept. 1),
Mining Engineering (Dept. 2),
Mechanical Engineering (Dept. 3),
Architecture (Dept. 4),
Engineering Physics (Dept. 5),
Chemical Engineering and Applied Chemistry (Dept. 6),
Electrical Engineering (Dept. 7),
Metallurgical Engineering (Dept. 8-8a).
Mining Geology (Dept. 9).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the courses in Engineering, and Bachelor of Architecture to those who complete the course in Architecture.

3. The courses in Engineering extend over four academic years; the course in Architecture extends over five. A student must pass in the work of each academic year before proceeding to the work of the next. See p. 145, para. 3.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 18, 1939.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction in Engineering and Architecture are given in Sec. IX, p. 25.

7. Examinations are conducted as explained in Sec. X, p. 145.

8. Students in Mining Engineering, Mechanical Engineering, Architecture, Electrical Engineering, and Mining Geology are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. (See Sec. IX, p. 25.)

9. Graduates in Engineering and Architecture may proceed to post graduate and professional degrees. The post graduate degrees include M. Arch., M.A.Sc., Ph.D., and the professional degrees, C.E., Chem. E., E.E., M.E. (Mechanical Engineer), M.E. (Mining Engineer), and Met. E.

The courses for these degrees are under the direction of the School of Graduate Studies, and candidates should send their inquiries to the Secretary of the School of Graduate Studies. Some of the requirements of these courses are given in an appendix to this Calendar.

SECTION VIII. SCHOOL OF ENGINEERING RESEARCH

THE SCHOOL

A School of Engineering Research, within the Faculty of Applied Science and Engineering, was established in the Spring of 1917 at the suggestion of the late Dean Ellis.

The School is under the direct supervision of a Committee of Management composed of members of the Faculty Council. To this Committee of the Council is entrusted the selection of researches to be undertaken under the auspices of the School, and the disposition of funds for conducting them.

The School was organized chiefly for the training of graduates in methods of research and for the carrying out of investigations. These latter may be problems relating to specific industries of raw materials and having a specific end in view, or general problems having to do with fundamental principles.

RESEARCH ASSISTANTS

A number of research assistants in the School of Engineering Research are appointed annually on salary in the various departments of the Faculty to carry on the work of research under direction of members of the staff. This work is accepted as partial fulfilment of the requirements for the degrees of M.A.Sc., M.Arch., and Ph.D. These research assistants are usually recent graduates, and are chosen from among those who have displayed special capacity for investigation in their undergraduate courses. Applicants should consult with members of the staff as soon as possible after the April examinations.

The facilities of the School are also open to graduates who desire to penetrate more deeply into particular phases of experimental work, or to undertake investigations either suggested by members of the staff or arising from their own work since graduation.

INQUIRIES

All communications should be sent to the Secretary of the Committee of Management, Mr. W. S. Wilson.

SECTION IX. CURRICULUM

The courses of instruction are designed to give the student a thorough grounding in the fundamentals of engineering or architecture, and, in addition, sufficient familiarity with the practical application of the principles to make him useful upon graduation. The courses are very similar in the First Year with the exception of those of Architecture, Engineering Physics, and Chemical Engineering. In the succeeding years specialization develops to some extent with provision in the Third and Fourth years for optional courses in some of the graduating departments.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As the future engineer is vitally concerned with the development of the country, it is essential that he be instructed in the rudiments of economics, administration, and business, which, with his scientific training, will enable him to increase his usefulness to the full.

In some graduating departments, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful training in methods of research. In this way the undergraduate course is linked with the graduate courses, and with the work of the School of Engineering Research (page 24).

As part of the laboratory instruction, excursions to places of technical interest, both in Toronto and elsewhere, are arranged by the staff. These excursions are treated as laboratory periods with the same requirements as to attendance and reports. The total transportation costs in any one year will probably not exceed ten dollars.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The program and regulations regarding the courses of study and examinations, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course to the conditions here laid down.

Communications relating to curricula, instruction, and examinations in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

DEPARTMENT OF CIVIL ENGINEERING

(Dept. 1)

The normal course in Civil Engineering has been so designed as to be broad and comprehensive, with a view to meeting not only the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire a techical training of such a basic character as to enable them to enter various other fields of technical employment. Concurrent with the instruction in engineering subjects, sufficient attention is given to economic, legal, and administrative matters to make the graduate in this Department fitted to enter not only upon such work as Municipal Engineering, Sanitary Engineering, Highway Engineering, Railway Engineering, Geodetic Surveying, Structural Engineering, and Hydraulic Engineering, but also upon adminis.rative and executive work in both engineering and industrial undertakings.

Those students who show special mathematical aptitude in the First and Second Years are permitted to select options in the Third and Fourth Years that include advanced mathematics and their application to certain fields of importance to the civil engineer.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 492, page 123

First Year Subjects Dept. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	500	3	–	4	–
Analytical Geometry and.....	492	1	–	2	–
Calculus...............	490	2	–	2	–
Applied Physics.............	75, 76	1	3	1	3
Business..................	310	–	–	1	–
Descriptive Geometry........	270	1	–	1	–
Dynamics..................	21	2	–	2	–
Electricity.................	330	2	–	2	–
Engineering Problems and Drawing..............	275	–	10	–	17
General Chemistry..........	220	2	–	1	–
Physical Training...........	640	–	2	–	2
Statics.....................	20	2	–	2	–
Surveying..................	710, 712	1	6	1	–
Technical English..........	610	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	501	2	–	2	–
Calculus....................	491	2	–	2	–
Analytical Chemistry Laboratory....................	226	–	–	–	6
Descriptive Geometry........	272	1	–	1	–
Economics and Finance......	311	1	–	1	–
Electricity..................	331, 350	1	–	1	3
Engineering Problems and Drawing...............	284	–	5	–	10
Engineering Chemistry.......	230	1	–	–	–
Geology, Elementary........	382	–	–	2	–
Inorganic Chemistry A.......	223	1	–	–	–
Least Squares...............	494	–	–	1	–
Mechanics of Materials......	23	2	–	2	–
Mineralogy, Primary........	582, 586	2	1	–	2
Organic Chemistry..........	233	–	–	1	–
Physical Metallurgy.........	546	–	–	1	–
Physical Training...........	640	–	2	–	2
Practical Astronomy.........	200	–	–	1	–
Public Speaking.............	320	–	–	1	–
Spherical Trigonometry......	493	1	–	–	–
Surveying..................	714, 716	1	9	1	–

Students in the Department of Civil Engineering who have obtained not less than 67 per cent in both Advanced Mathematics (500) of the First Year, and Advanced Mathematics (501) of the Second Year, may select either the Structural Option, *c*, or the Aeronautical Design Option, *d*, for the Third and Fourth Years. Permission to enter upon either of these Options may be withheld if the conditions existing at the time render it impracticable to give the work.

Third Year Subjects Dept. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 1a, General					
Option 1b, Astronomy					
Applied Elasticity	33	1	–	1	–
Astronomy and Geodesy	201	2	–	2	–
Cements and Concrete	35	1	–	1	–
Descriptive Geometry	274	1	–	–	–
Engineering Chemistry	240	1	–	1	–
Engineering Problems and Drawing	291	–	13	–	14
Engineering Geology	387	1	–	1	–
Field Work	202	–	2	–	–
Graphical Methods	32	1	–	1	–
Heat Engines, Theory	427, 428	1	–	1	2
Hydraulics	440, 441	2	–	2	3
Machinery	463, 464	1	–	1	3
Mechanics of Materials Lab.	31	–	5	–	–
Survey Camp	718	–	–	–	–
Surveying	717	1	–	1	–
Theory of Structures	28	2	–	2	–
Option 1c, Structural					
Advanced Engineering Mechanics	27	1	–	1	–
Applied Elasticity	33	1	–	1	–
Cements and Concrete	35	1	–	1	–
Descriptive Geometry	274	1	–	–	–
Differential Equations	507	1	–	1	–
Elementary Machine Design	471, 472	1	2	1	2
Engineering Problems and Drawing	291	–	14	–	18
Graphical Methods	32	1	–	1	–
Integral Calculus and Differential Equations	505	3	–	3	–
Introduction to the Theory of Functions	508	1	–	1	–
Mechanics of Materials Lab.	31	–	5	–	–
Survey Camp	718	–	–	–	–
Surveying	717	1	–	1	–
Theory of Structures	28	2	–	2	–

THIRD YEAR SUBJECTS DEPT. 1—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 1d, Aeronautical Design					
Advanced Engineering Mechanics	27	1	–	1	–
Aircraft	1, 2	1	–	1	3
Applied Elasticity	33	1	–	1	–
Cements and Concrete	35	1	–	1	–
Descriptive Geometry	274	1	–	–	–
Differential Equations	507	1	–	1	–
Elementary Machine Design	471, 472	1	2	1	2
Engineering Problems and Drawing	291	–	7	–	7
Graphical Methods	32	1	–	1	–
Heat Engine Laboratory	430	–	–	–	3
Hydrodynamics	662	1	–	1	–
Integral Calculus and Differential Equations	505	3	–	3	–
Introduction to the Theory of Functions	508	1	–	1	–
Mechanics of Materials Lab.	31	–	5	–	–
Survey Camp	718	–	–	–	–
Theory of Structures	28	2	–	2	–
Thermodynamics	429	2	–	2	–

FOURTH YEAR SUBJECTS DEPT. 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 1a, General					
Contracts and Specifications..	315	–	–	1	–
Engineering Economics......	313	–	–	1	–
Engineering Law............	314	2	–	–	–
Foundations................	39	1	–	1	–
Hydraulics.................	445, 446	1	3	1	–
Management................	316	1	–	–	–
Mechanics of Materials Lab...	38	–	3	–	3
Miscellaneous Structures.....	45	–	–	1	–
Reinforced Concrete.........	41	1	–	1	–
Structural Design...........	43, 44	2	–	1	–
Theory of Structures.........	36	2	–	2	–
Thesis.....................	730	–	3	–	–
And *one* of the following Elective Groups:					
(1) Engineering Problems and Drawing...........	298	–	15	–	15
	301	–	–	–	3
Highway Engineering....	631, 632	–	–	1	3
Municipal Administration	319	–	–	1	–
Sanitary Engineering....	630	1	–	1	–
Soil Mechanics..........	40	1	–	–	–
(2) Engineering Problems and Drawing...........	298	–	12	–	18
Photographic Surveying..	81, 82	3	3	2	3
Option 1b, Astronomy					
Astronomy, Advanced.......	203	2	–	2	–
Astronomy, Geodesy, Metrology..................	205	–	23	–	23
Contracts and Specifications..	315	–	–	1	–
Engineering Economics.......	313	–	–	1	–
Engineering Law............	314	2	–	–	–
Geodesy...................	204	2	–	2	–
Management...............	316	1	–	–	–
Photographic Surveying......	83, 84	1	2	1	2
Survey Camp..............	718	–	–	–	–
Thesis.....................	730	–	3	–	–

FOURTH YEAR SUBJECTS DEPT. 1—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 1c, Structural					
Advanced Structural Analysis.	37	–	–	2	–
Applied Elasticity...........	34	1	3	1	3
Contracts and Specifications..	315	–	–	1	–
Differential Equations of Mathematical Physics...	521	2	–	2	–
Engineering Economics.......	313	–	–	1	–
Engineering Problems and Drawing...............	298	–	11	–	10
Foundations................	39	1	–	1	–
Mechanics of Materials Lab...	38	–	3	–	3
Miscellaneous Structures.....	45	–	–	1	–
Reinforced Concrete.........	41	1	–	1	–
Structural Design...........	43, 44	2	–	1	–
Theory of Elasticity.........	522	1	–	1	–
Theory of Structures.........	36	2	–	2	–
Thesis.....................	730	–	3	–	–
Vibration Engineering.......	48, 49	1	3	1	3
Option 1d, Aeronautical Design					
Aerodynamics...............	3, 4	1½	3	1½	3
Aircraft Engines............	431	1	–	1	–
Airplane Design.............	5, 6	2	9	2	9
Airplane Stress Analysis......	7	1½	–	1½	–
Differential Equations of Mathematical Physics....	521	2	–	2	–
Engineering Economics.......	313	–	–	1	–
Engineering Problems and Drawing...............	298	–	3	–	7
Foundations................	39	1	–	1	–
Hydrodynamics.............	8	2	–	2	–
Mechanics of Materials Lab...	38	–	3	–	3
Reinforced Concrete.........	41	1	–	1	–
Theory of Structures.........	36	2	–	2	–
Thesis.....................	730	–	3	–	–

DEPARTMENT OF MINING ENGINEERING

(Dept. 2)

The course in Mining Engineering, which originated in 1878 as a course in Assaying and Mining Geology, is intended to serve as a preliminary training for those who expect to practise in some branch of Mining Engineering, such as exploration of mining areas and primary development, mine surveying, mining processes involving civil, mechanical and electric work of underground workings, mining machinery and operation; milling and treatment of ores, assaying and other forms of analysis and research, and administrative work in both engineering and industrial undertakings.

A candidate for the degree in the Department of Mining Engineering will be required to present satisfactory evidence of having had at least six months' practical experience in work connected with mining, metallurgy, or geology, for which he must have received regular wages.

The time may be spent in geological survey, ore dressing, smelter, or lixiviation works, in an assay office in the vicinity of mining or metallurgical works, in prospecting, or on any work in or about a mine other than as an office man or clerk. Prospecting will only count one-half (*e.g.*, four months' prospecting will be counted as two months) and must not be submitted for more than three of the six months. Not more than three months on geological surveys or in assaying will be accepted as part of the six months.

It is important to note that this experience may be put in before the student is admitted to the University.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 492, page 123.

First Year Subjects Dept. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	500	3	–	4	–
Analytical Geometry, and....	492	1	–	2	–
Calculus...............	490	2	–	2	–
Business..................	310	–	–	1	–
Descriptive Geometry........	270	1	–	1	–
Dynamics..................	21	2	–	2	–
Electricity.................	330	2	–	2	–
Engineering Problems and Drawing...............	276	–	9	–	12
General Chemistry..........	220	2	–	1	–
Mineralogy.................	581, 583	2	1	–	1
Mining Laboratory..........	165	–	–	–	3
Petrography, Elementary.....	588	–	–	1	1
Physical Training...........	640	–	2	–	2
Problems and Seminar.......		–	3	–	3
Statics.....................	20	2	–	2	–
Surveying..................	710, 712	1	6	1	–
Technical English...........	610	1	–	1	–

Second Year Subjects Dept. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory....................	226, 227	–	6	–	6
Descriptive Geometry........	272	1	–	1	–
Economics and Finance......	311	1	–	1	–
Electricity..................	331, 350	1	–	1	3
Engineering Problems and Drawing...............	285	–	3	–	10
General Geology............	388, 389	2	–	1	2
Heat Engines, Elementary....	420	1	–	–	–
Inorganic Chemistry A.......	223	1	–	–	–
Inorganic Chemistry B.......	224	–	–	1	–
Mechanics of Materials......	23	2	–	2	–

SECOND YEAR SUBJECTS DEPT. 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Metallurgy, Elementary......	530	–	–	1	–
Mineralogy.................	589	–	2	–	2
Mining.....................	167, 169	1	3	–	–
Physical Training...........	640	–	2	–	2
Problems and Seminar.......		–	3	–	3
Surveying..................	715, 716	1	6	1	–
Theory of Measurements.....	182	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry........	225, 227	1	6	1	3
Assaying...................	160, 161	1	3	–	3
Economic Geology...........	398, 399	1	2	3	–
Engineering Chemistry.......	240	1	–	1	–
Engineering Problems and Drawing...............	292	–	6	–	3
Geological Field Work.......	380	–	–	–	–
Hydraulics.................	440, 441	2	–	2	3
Introductory Research.......	183	–	3	–	–
Metallurgy.................	532	1	–	1	–
Mining.....................	170	1	–	1	–
Ore Dressing...............	175, 176	1	–	1	6
Petrography, General........	590, 591	1	2	1	2
Physics of Ore Dressing......	181	1	–	1	–
Problems and Seminar.......		–	3	–	3
Summer Letters.............	690	–	–	–	–
Survey Camp...............	718	–	–	–	–
Theory of Structures.........	29	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	162, 163	–	–	1	3
Electrical Laboratory	350	–	3	–	–
Engineering Economics	313	–	–	1	–
Geology, Precambrian and Mining	392, 396	2	–	2	–
Geology, Pleistocene and Physiographic	381, 397	1	1	1	–
Heat Engines, Theory	427, 428	1	3	1	–
Machine Design	469, 470	1	–	1	3
Mechanics of Materials Lab.	31	–	–	–	3
Metallurgy	538, 539	1	–	1	6
Mine Cost-Finding and Management	172	1	–	1	–
Mine Ventilation	173, 174	2	3	–	–
Mining	171	1	–	1	–
Ore Dressing	177, 178	1	6	1	–
Problems and Seminar		–	3	–	3
Summer Letters	691	–	–	–	–
Thesis	731	–	7	–	10

DEPARTMENT OF MECHANICAL ENGINEERING
(DEPT. 3)

The mechanical engineer is concerned with the production and the use of power, and it is part of his work to design and manufacture suitable machinery for this purpose, and to instal and operate it. The Diesel engine and the steam turbine are the products of his effort, and he applies these prime movers to automobiles, aeroplanes, locomotives, and other purposes. His work also includes the design of water turbines and their use in hydro-electric systems.

Other branches of his work are the making of designs for air compressors, machine tools, pumps, refrigerating machines and their application to storage warehouses and ice-making, heating and ventilating equipment, materials-handling and conveying plants, and generally all mechanical work. General industrial and administrative problems are considered.

An effort is being made to help qualified students interested in the design of aeroplanes and high speed trains and cars, without laying undue stress on such work. Courses of lectures are provided and in the final year some laboratory work in the wind tunnel is sometimes given.

The following course of study has been devised to equip men for this service.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 492, page 123.

SHOP WORK

Every student registered in the Department of Mechanical Engineering is required to spend 1200 hours in mechanical work satisfactory to the Department. Half of this work is required to be done before the student commences his Third Year Annual Examinations in April, and the balance before he commences his Fourth Year Annual Examinations in April. The details in this regard are outlined in the Calendar under subjects 692 and 693.

All or any part of this shop work may be completed before the student enters the University, and he is urged to complete all of it at as early a date in his course as possible.

Failure to meet the specified requirements within the time set will result in a failure in shop work, which will be dealt with similarly to a failure in any laboratory subject.

Certificate forms for this work may be obtained from the Secretary of the Faculty or from the Department.

FIRST YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	500	3	–	4	–
Analytical Geometry and.....	492	1	–	2	–
Calculus...............	490	2	–	2	–
Applied Physics............	70, 71	1	3	1	3
Business..................	310	–	–	1	–
Descriptive Geometry.......	270	1	–	1	–
Dynamics.................	21	2	–	2	–
Electricity.........	330	2	–	2	–
Engineering Problems and Drawing...............	277	–	9	–	15
General Chemistry..........	220	2	–	1	–
Machines and Processes......	460	1	–	1	–
Physical Training...........	640	–	2	–	2
Properties of Fluids..........	448	1	–	1	–
Statics....................	20	2	–	2	–
Surveying.................	710, 712	1	4	–	–
Technical English...........	610	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	501	2	–	2	–
Calculus..................	491	2	–	2	–
Analytical Chemistry Laboratory..................	226	–	–	–	6
Descriptive Geometry........	272	1	–	1	–
Dynamics.................	22	1	–	1	–
Economics and Finance......	311	1	–	1	–
Electrical Measurements.....	332, 334	2	3	2	3
Engineering Chemistry.......	230	1	–	–	–
Engineering Problems and Drawing...............	286	–	15	–	8
Heat Engines, Elementary....	420	1	–	1	–
Hydrostatics................	447	–	–	1	–
Inorganic Chemistry A.......	223	1	–	–	–
Machines and Processes......	461	1	–	1	–
Mechanics of Materials......	23, 31	2	–	2	3
Metallurgy, Elementary......	530	–	–	1	–
Organic Chemistry..........	233	–	–	1	–
Physical Training...........	640	–	2	–	2
Properties of Fluids..........	449	1	–	1	–
Theory of Mechanism........	465	2	–	2	–

THIRD YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Currents	340	1	–	1	–
Direct Current Machines	338	1	–	1	–
Electrical Laboratory	346	–	4½	–	3
Engineering Chemistry	240	1	–	1	–
Engineering Problems and Drawing	293	–	6	–	3
Heat Engines, General	422	2	–	2	–
Heat Engines, Theory	421, 423	2	3	2	3
Hydraulics	440, 441	2	–	2	3
Machine Design	467, 468	2	8	2	8
Mechanics of Machinery	466	1	–	1	–
Physical Metallurgy	533	–	–	2	–
Shop Work	692	–	–	–	–
Theory of Structures	29	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Engineering Economics	313	–	–	1	–
Engineering Law	314	1	–	–	–
Engineering Problems and Drawing	299	–	3	–	–
Heat Engine Laboratory	426	–	7½	–	7½
Heat Power Engineering	424	2	–	2	–
Heat Transmission and Refrigeration; Internal Combustion	425	1	–	1	–
Heat Treatment of Iron and Steel	547, 548	1	–	1	1½
Hydraulics	442, 443, 444	3	8	3	6
Industrial Management	318	1	–	1	–
Reinforced Concrete	46	1	–	–	–
Machine Design, Advanced	473, 474	2	6	2	8
Shop Work	693	–	–	–	–
Structural Design	43, 44	2	–	–	–
Thesis	732	–	1	–	1

SHOP WORK

Attention is directed to the note on shop work on page 36

SCHOOL OF ARCHITECTURE
(DEPT. 4)

The School of Architecture was established as a Department of the Faculty of Applied Science and Engineering in 1890, and is one of the oldest schools in the British Empire. The School is fortunate in enjoying a close connection with the Ontario Association of Architects and the Royal Architectural Institute of Canada, both of which organizations offer prizes and scholarships for competition in the School.

The School is one of a limited number in the Empire recognized by the Royal Institute of British Architects, which admits graduates to Associate Membership on application, without examination. The Ontario Association of Architects, through its Registration Board, accepts the degree in Architecture, coupled with a twelve months period of office experience with an architect as qualification to practise the profession of Architecture in the Province of Ontario. As a matter of fact, few graduates commence practice without a continuation of their practical training, and a year or two years' travel or additional experience in the employ of an architect in Canada or abroad is recommended.

In the Fourth and Fifth Years, students may select either the Design Option or the Structural Option. In selecting the latter option, the student decides that his interests tend toward the engineering side of Architecture. Subjects closely related to architecture, such as town planning and housing, modelling, water colour, drawing, etc., take their proper place in the course and are described in the following pages. An event in the academic year is the period at Gull Lake, a University Camp, where a week is spent under supervision, sketching out of doors.

Broadly speaking, the course is arranged to lay a foundation for the subsequent life of the graduate. A very considerable portion of the course is devoted to architectural design, and a student graduating should have a thorough knowledge of the principles of this important subject. He should have formed a taste and developed an appreciation of the allied arts, which should make him a valuable member of any community.

OFFICE EXPERIENCE

Every student registered in the School of Architecture is required to spend at least 12 months (1,900 hrs.) in practical work and satisfactory evidence of its completion must be submitted before the granting of a degree. This work is done during the summer vacations, and is normally done in an architect's office for the whole period of 12 months. In exceptional cases, a student may, on application to the School of Architecture, be given permission to spend up to 6 months of this period with a recognized contractor or other firm conducting work in connection with building. At least 6 months' practical work in a recognized architect's office is obligatory.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects, referring to a more detailed description, *e.g.*, History of Architecture, 110, page 77.

First Year Subjects Dept. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Advanced Mathematics or....	500	3	–	4	–
Analytical Geometry and.....	492	1	–	2	–
Calculus...............	490	2	–	2	–
Architectural Design.........	121	–	14	–	17
Building Construction.......	140	–	–	1	–
Descriptive Geometry........	271	1	–	1	–
Elements of Arch. Form......	118	1	–	1	–
Engineering Problems and Drawing...............	278	–	3	–	3
Freehand Drawing..........	131	–	2	–	2
French.....................	618	2	–	2	–
History of Architecture......	110	1	–	1	–
Physical Training...........	640	–	2	–	2
Statics.....................	20	2	–	2	–
Surveying..................	711, 713	1	3	–	–
Technical English..........	610	1	–	1	–

Second Year Subjects Dept. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Design.........	122	–	18	–	18
Descriptive Geometry........	273	1	–	1	–
Economics and Finance......	311	1	–	1	–
English...................	611	1	–	1	–
Freehand Drawing..........	132	–	2	–	2
French.....................	619	1	–	1	–
History of Architecture......	111	1	–	1	–
Mechanics of Materials......	25	2	–	2	–
Modelling..................	137	–	2	–	2
Photography................	77, 78	1	3	1	3
Physical Training...........	640	–	2	–	2
Theory of Arch. Planning....	128	1	–	1	–
Vacation Work..............	694	–	–	–	–

THIRD YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Architectural Composition....	129	1	–	1	–
Architectural Design.........	123	–	20	–	22
Colour.....................	136	1	–	–	–
Commercial Law............	312	1	–	1	–
Freehand Drawing..........	133	–	2	–	2
Functional Requirements of Buildings...............	114	1	–	1	–
Garden Design.............	116	1	–	–	–
History of Architecture A....	112	1	–	–	–
History of Architecture B....	113	–	–	1	–
History of Sculpture.........	120	1	–	–	–
Light and Acoustics.........	85, 86	1	2	1	2
Modelling..................	138	–	2	–	2
Public Speaking.............	320	1	–	–	–
Structural Design...........	30	1	3	1	3
Vacation Work..............	695	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Building Materials..........	141	–	–	1	–
Building Stones.............	405	1	–	–	–
Ceramic Building Materials...	569	–	–	1	–
Contracts and Specification...	315	–	–	1	–
Freehand Drawing...........	134	–	2	–	2
Functional Requirements of Buildings...............	115	1	–	1	–
Garden Design..............	116	1	–	–	–
History of Painting..........	119	1	–	1	–
Illumination Design.........	87, 88	1	1	1	1
Modelling..................	139	–	2	–	2
Sanitary Science............	142	1	–	1	–
Structural Design...........	42	1	3	1	3
Vacation Work..............	696	–	–	–	–
and either					
Architectural Design, *or*......	124	–	20	–	20
Architectural Engineering....	126	1	19	1	19

FIFTH YEAR SUBJECTS DEPT. 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Studio	Lect.	Studio
Arch. Aspects of Town Planning	130	–	–	1	–
Architectural Economics.....	145	1	–	1	–
Garden Design..............	116	1	–	–	–
Heating and Air Conditioning.	144	1	–	1	–
Mural Painting.............	135	–	2	–	2
Professional Practice.........	143	1	–	1	–
Structural Design...........	47	1	3	1	3
Town Planning and Housing..	117	–	–	2	–
and either					
Architectural Design, *or*	125	–	26	–	26
Architectural Engineering....	127	2	24	2	24

DEPARTMENT OF ENGINEERING PHYSICS
(DEPT. 5)

Admission to this course is granted only to students who meet the special requirements set forth on page 17 of this Calendar.

The course is designed to afford a training in Mathematics and Physics beyond that which it is possible to give in the other undergraduate courses in engineering. It is believed that a wider and more thorough acquaintance with the basic sciences will bring to the student a readier appreciation of the nature of the technical problems with which he will later be confronted and a greater facility in the solution of them. A course of the kind offered should consequently be of particular value to those who desire to enter governmental or industrial research laboratories, or who wish to engage in any original work of investigation or development in the field of applied physics.

Throughout the four years of the course an effort is made to maintain the practical point of view in the theoretical instruction. This is effected, in part, by adopting wherever possible the engineering viewpoint in the teaching of mathematical and scientific subjects, and, in part, by the inclusion of certain basic engineering instruction.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Algebra and Calculus, 502, page 124.

FIRST YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Algebra and Calculus	502	$3\frac{1}{2}$	–	$3\frac{1}{2}$	–
Analytical Geometry	503	$1\frac{1}{2}$	–	$1\frac{1}{2}$	–
Descriptive Geometry	270	1	–	1	–
Electricity	330	2	–	2	–
Engineering Problems and Drawing	279	–	3	–	6
Engineering Mechanics	26	2	–	2	–
General Chemistry	221	2	–	1	–
German	616	2	–	2	–
Inorganic Chemistry Laboratory	222	–	3	–	3
Physical Training	640	–	2	–	2
Properties of Matter, Mechanics and Heat	650, 651	3	$4\frac{1}{2}$	3	$4\frac{1}{2}$

SECOND YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Geometry of Space.	506	1	–	1	–
Descriptive Geometry........	272	1	–	1	–
Differential Calculus.........	504	3	–	3	–
Electrical Measurements.....	332, 335	2	3	2	–
Elementary Acoustics........	654	1	–	–	–
Elementary Light...........	653	1	–	1	–
Elementary Machine Design..	471, 472	1	3	1	3
Elementary Magnetism and Electricity..............	652	1	–	2	–
Engineering Chemistry.......	230	1	–	–	–
German....................	617	1	–	1	–
Integral Calculus and Differential Equations...........	505	3	–	3	–
Mechanics of Materials......	24, 31	2	–	2	3
Organic Chemistry..........	233	–	–	1	–
Physics Laboratory..........	655	–	3	–	6
Physical Training...........	640	–	2	–	2

Students in the Department of Engineering Physics are required to state at the beginning of the Third Year the options they desire to pursue in the Third and Fourth Years. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give the work.

For students who registered prior to the Session 1939-40 and who wish to pursue Option 5*e*, Elasticity of Materials and Structures, the curriculum will be as in the Calendar for the Session 1938-39.

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Engineering Mechanics	27	1	–	1	–
Alternating Currents	341	1	–	1	–
Differential Equations	507	1	–	1	–
Direct Current Machines	339	1	–	1	–
Heat	658	1	–	1	–
Introduction to the Theory of Functions	508	1	–	1	–
Physical Laboratory	659	–	3	–	3
Physical Metallurgy	533	–	–	2	–
Properties of Matter	657	2	–	2	–
Theoretical Mechanics	520	1	–	1	–

And *one* of the following options which must be continued in the Fourth Year.

Option 5c, Electricity and Communications					
Option 5s, X-Rays and Spectroscopy					
Option 5i, Illumination and Acoustics					
Electrical Design	342	1	–	1	–
Electrical Laboratory	345	–	6	–	6
Mathematical Operations applied to Physics	656	1	–	1	–
Optics	660, 661	1	3	1	3
Option 5g, Geophysics					
Electrical Laboratory	345	–	6	–	6
Geology, Elementary	382	–	–	2	–
Optics	660, 661	1	3	1	3
Petrography, Elementary	587	1	–	–	1

THIRD YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5h, Applied Hydro-mechanics					
Aircraft	1, 2	1	–	1	3
Electrical Laboratory	347	–	3	–	3
Engineering Problems and Drawing	294	–	3	–	3
Heat Engine Laboratory	430	–	–	–	3
Hydrodynamics	662	1	–	1	–
Mathematical Operations Applied to Physics	656	1	–	1	–
Theory of Structures	29	1	–	1	–
Thermodynamics	429	2	–	2	–

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5c, Electricity and Communications					
Acoustics	360	1	–	–	–
Acoustics, Advanced	664	1	–	–	–
Alternating Current Circuit Analysis	351	2	–	2	–
Communication	361, 363	–	–	2	6
Conduction through Gases, Radioactivity, and Atomic Structure	663	1	–	1	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electrical Laboratory	356	–	6	–	6
Electrical Transmission of Energy	352	1	–	1	–
Electromagnetic Theory, Applied	365	2	–	2	–
Mathematical Operations Applied to Physics	656	1	–	1	–
Operational Methods	364	2	–	2	–
Physical Laboratory	665	–	3	–	3
Thermionic Tubes	357, 359	2	6	–	–
Thesis	733	–	–	–	–
Option 5s, X-Rays and Spectroscopy					
Acoustics	149	1	–	–	–
Acoustics, Advanced	664	1	–	–	–
Communication	361, 363	–	–	2	6
Conduction through Gases, Radioactivity, and Atomic Structure	663	1	–	1	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
Elementary Quantum Theory	668	–	–	1	–
Mathematical Operations Applied to Physics	656	1	–	1	–
Morphological Crystallography	594	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week First Term Lect.	First Term Lab.	Second Term Lect.	Second Term Lab.
Option 5s, X-Rays and Spectroscopy (continued)					
Operational Methods........	364	2	–	2	–
Optics, Advanced............	666	1	–	1	–
Organic Chemistry..........	250	1	–	1	–
Physical Laboratory.........	665	–	9	–	9
Series Spectra...............	667	–	–	1	–
Thermionic Tubes...........	357, 359	2	6	–	–
Thesis.....................	733	–	–	–	–
X-Rays and Crystal Structure.	669	1	–	1	–
Option 5g, Geophysics					
Differential Equations of Mathematical Physics....	521	2	–	2	–
Economic Geology...........	398, 400	1	3	3	3
Electromagnetic Theory, Applied................	365	2	–	2	–
Geophysics.................	670, 671	2	9	2	9
Location of Mineral Deposits..	401	–	–	2	–
Mining Geology.............	396	–	–	2	–
Organic Chemistry..........	250	1	–	1	–
Petrography, General........	590, 591	1	2	1	2
Precambrian Geology........	392	2	–	–	–
Wave Motion in Elastic Media.	672	1	–	1	–
Option 5h, Applied Hydromechanics					
Aerodynamics...............	3, 4	$1\frac{1}{2}$	6	$1\frac{1}{2}$	6
Aircraft Engines.............	431	1	–	1	–
Airplane Design.............	5, 6	2	9	2	9
Airplane Stress Analysis......	7	$1\frac{1}{2}$	–	$1\frac{1}{2}$	–
Differential Equations of Mathematical Physics....	521	2	–	2	–
Mathematical Operations Applied to Physics	656	1	–	1	–
Theoretical Hydrodynamics ..	523	2	–	2	–
Thesis.....................	733	–	4	–	4

FOURTH YEAR SUBJECTS DEPT. 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5i, Illumination and Acoustics					
Acoustics, Advanced	664	1	–	–	–
Architectural Acoustics	89, 90	1	3	3	9
Differential Equations of Mathematical Physics	521	2	–	2	–
Mathematical Operations Applied to Physics	656	1	–	1	–
Operational Methods	364	2	–	2	–
Photometry and Illumination Design	95, 96	2	6	2	6
Physical Laboratory	674	–	3	–	3
Physics of Light Production	673	1	–	1	–
Thermionic Tubes	357, 359	2	6	–	–

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(Dept. 6)

The course is designed to give the student a thorough training in the underlying principles and laboratory methods of inorganic, organic, physical, and analytical chemistry, in the applications of these to industrial chemistry and chemical engineering, and a general knowledge of the elements of thermodynamics, hydraulics, machine design, structural design, electricity, and metallurgy. A preliminary training of this nature with subsequent practical experience will enable him to undertake the design and construction, also the operation and management of the plant required in such branches of chemical industry as are concerned with the production of chemical and pharmaceutical products, petroleum and its products, rubber goods, leather and glue, soap, meat products, foodstuffs, vegetable and animal oils, sugar, pulp and paper, vegetable and animal fibres, artificial silk, plastics, coal tar and wood distillates, paints and varnishes, explosives, dyes, portland cement, metals and their alloys, electrochemical products, fermentation products, fertilizers, synthetic chemical products, etc.

For those who by temperament and ability are attracted to chemical research there exist excellent opportunities in government, industrial, and medical research laboratories. Properly qualified students wishing to pursue experimental investigation as a life-work, whether in industrial chemistry or in purely scientific chemistry, may proceed in this department to the degrees M.A.Sc. and Ph.D., the laboratory research work of the Fourth Year serving as a connecting link between the undergraduate and graduate courses.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 492, page 123.

FIRST YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	500	3	–	4	–
Analytical Geometry and.....	492	1	–	2	–
Calculus...............	490	2	–	2	–
Biology, Elementary.........	210	–	–	–	3
Business....................	310	–	–	1	–
Descriptive Geometry........	270	1	–	1	–
Dynamics..................	21	2	–	2	–
Electricity.................	330	2	–	2	–
Engineering Problems and Drawing...............	280	–	3	–	3
General Chemistry..........	221	2	–	1	–
German....................	612	2	–	2	–
Inorganic Chemistry Laboratory..................	222	–	12	–	12
Mineralogy................	580, 585	2	1	–	1
Optics....................	72, 73	1	3	1	–
Physical Training...........	640	–	2	–	2
Statics....................	20	2	–	2	–
Technical English...........	610	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	501	2	–	2	–
Calculus....................	491	2	–	2	–
Chemical Laboratory........	229, 235	–	10	–	8
Economics and Finance......	311	1	–	1	–
Electrical Measurements.....	332, 334	2	3	2	3
Elementary Machine Design..	462	1	–	1	–
Engineering Chemistry.......	230	1	–	–	–
Engineering Problems and Drawing..............	287	–	7	–	3
German....................	613	1	–	1	–
Hydrostatics................	447	–	–	1	–
Industrial Chemistry........	231	1	–	1	–

Second Year Subjects Dept. 6—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Industrial Chemistry Laboratory	232	–	–	–	5
Inorganic Chemistry A	223	1	–	–	–
Inorganic Chemistry B	224	–	–	1	–
Mechanics of Materials	23	2	–	2	–
Metallurgy, Elementary	530	–	–	1	–
Optics Laboratory	74	–	–	–	1
Organic Chemistry	234	2	–	2	–
Physical Chemistry	236	2	–	2	–
Physical Training	640	–	2	–	2

Third Year Subjects Dept. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Currents	340	1	–	1	–
Analytical Chemistry	225	1	–	1	–
Assaying Laboratory	164	–	3	–	–
Chemical Laboratory	238, 243, 245	–	13	–	13
Chemical Engineering	242	1	–	1	–
Electrical Laboratory	349	–	–	–	3
Electrochemistry	246, 247	2	3	–	–
Engineering Chemistry	240	1	–	1	–
Engineering Problems and Drawing	295	–	3	–	3
German	614	1	–	1	–
Heat Engines, Theory	421, 428	2	–	2	1½
Hydraulics	440, 441	2	3	2	–
Industrial Chemistry	241	1	–	1	–
Metallurgy	532	1	–	1	–
Organic Chemistry	244	2	–	2	–
Physical Metallurgy	533	–	–	2	–
Theory of Structures	29	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory........	251	–	17	–	–
Engineering Law............	314	1	–	–	–
German, *or*	615	1	–	1	–
Spanish................	620	1	–	1	–
Industrial Management......	318	1	–	1	–
Inorganic Chemistry.........	248	2	–	2	–
Machine Design.............	469, 470	1	–	1	3
Organic Chemistry..........	249	1	–	1	–
Thesis.....................	734	–	–	–	–
and *one* of					
1. Electrochemistry..........	255, 256	2	*	2	*
2. Industrial Chemistry......	252, 253, 254	1	*	3	*
3. Metallurgy and	538, 539	1	*	1	*
Ore Dressing and	179, 180, 181	2	–	2	6
Physical Metallurgy.	543, 544	2	3	1	3
4. Ceramics................	560	4	*	2	*
	561	–	6	–	9
	565	2	*	1	*
5. Zymology................	750	*	*	*	*

*All time not otherwise allotted must be spent in the various laboratories in the proportions assigned by the Department.

For information regarding the courses of study leading to the degrees, Master of Applied Science and Doctor of Philosophy, see pp. 187 and 189 of this calendar, also the calendar of the School of Graduate Studies which gives full particulars.

DEPARTMENT OF ELECTRICAL ENGINEERING
(DEPT. 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields in addition to that of his specialty, electrical technique. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but also heat engines, hydraulics, theory of mechanisms, machine design, business, economics and finance, commercial law, and other non-electrical subjects.

In the electrical field much time is given to the calculation of circuits of electric, magnetic, and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets, and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years. Certain options in this Year are available in combination with general electrical engineering, viz., hydraulics, heat engines, communication and illumination.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial, or administrative responsibilities.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry, 492, page 123.

FIRST YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	500	3	3	4	3
Analytical Geometry and.....	492	1	3	2	3
Calculus................	490	2		2	
Applied Physics.............	70, 71	1	3	1	3
Business....................	310	–	–	1	–
Descriptive Geometry........	270	1	–	1	–
Dynamics....................	21	2	–	2	–
Electricity.................	330	2	–	2	–
Engineering Problems and Drawing...............	281	–	9	–	12
General Chemistry...........	220	2	–	1	–
Physical Training...........	640	–	2	–	2
Practical Experience.........	697	–	–	–	–
Statics.....................	20	2	–	2	–
Surveying...................	710, 712	1	4	–	–
Technical English...........	610	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	501	2	3	2	3
Calculus....................	491	2	3	2	3
Analytical Chemistry Laboratory...................	226	–	6	–	–
Descriptive Geometry........	272	1	–	1	–
Dynamics....................	524	1	1	1	1
Economics and Finance......	311	1	–	1	–
Electrical Measurements	332, 334	2	3	2	3
Electrical Fundamentals.....	333	1	–	1	–
Elementary Machine Design..	462	1	–	1	–
Engineering Chemistry.......	230	1	–	–	–
Engineering Problems and Drawing...............	288	–	6	–	9
Heat Engines, Elementary....	420	1	–	1	–
Hydrostatics................	447	–	–	1	–
Inorganic Chemistry A.......	223	1	–	–	–
Mechanics of Materials......	23	2	–	2	–
Physical Training...........	640	–	2	–	2
Practical Experience.........	697	–	–	–	–
Theory of Mecharism........	465	2	–	2	–

THIRD YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Currents	341	1	–	1	–
Commercial Law	312	1	–	1	–
Direct Current Machines	339	1	–	1	–
Electrical Design	342	1	–	1	–
Electrical Problems and Design Laboratory	343	–	6	–	6
Electrical Laboratory	344	–	6	–	6
Engineering Chemistry	240	1	–	1	–
Heat Engines, Theory	421, 423	2	3	2	–
Hydraulics	440, 441	2	–	2	3
Machine Design	467, 468	2	3	2	3
Mathematical Applications in Electrical Engineering	336	1	–	1	–
Mechanics of Machinery	466	1	–	1	–
Physical Metallurgy	533	–	–	2	–
Practical Experience	697	–	–	–	–
Thermionic Tubes	337	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Current Circuit Analysis	351	2	–	2	–
Alternating Current Machinery	353	2	–	2	–
Alternating Current Measurements	354	1	–	1	–
Electrical Laboratory	355	–	16	–	16
Electrical Transmission of Energy	352	1	–	1	–
Engineering Economics	313	–	–	1	–
Engineering Law	314	1	–	–	–
Industrial Management	318	1	–	1	–
Practical Experience	697	–	–	–	–
Thesis	735	–	–	–	–
and *one* of					
1. Communication	357, 358, 360 361, 362	3	9	2	9
2. Heat Engines	424, 425, 426	3	6	3	6
3. Hydraulics	442, 443, 444	3	6	3	6
4. Illumination	91, 92, 93, 94	3	6	3	6

DEPARTMENT OF METALLURGICAL ENGINEERING
(DEPT. 8-8a)

Two separate courses of instruction are offered in this department. These are designated 8 and 8a. Course 8 deals with the treatment of ores and the metals from metallic minerals. Course 8a deals with the Ceramic and industrial non-metallic mineral field.

Course 8 is planned for those who intend to pursue Engineering work in connection with the milling or concentration of ores, the production of metals from ores or concentrates, the refining of metals, or the manufacture and fabrication of steel and other alloys.

Course 8a offers a training for those who intend to work as Engineers in the ceramic and non-metallic mineral industries. Ceramics deals with the preparation of raw materials for and the manufacture of such products as refractories, cement, heavy clay products, porcelain, glass, and enameled iron. Non-metallic mineral engineering includes the beneficiation and commercial utilization of such materials as asbestos, clay, diatomite, feldspar, gypsum, limestone, quartz, and talc.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Analytical Geometry 492, page 123.

FIRST YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	500	3	–	4	–
Analytical Geometry and.....	492	1	–	2	–
Calculus..............	490	2	–	2	–
Business....................	310	–	–	1	–
Descriptive Geometry........	270	1	–	1	–
Dynamics...................	21	2	–	2	–
Electricity..................	330	2	–	2	–
Engineering Problems and Drawing..............	282	–	13	–	19
General Chemistry..........	221	2	–	1	–
Mineralogy.................	580, 584	2	1	–	–
Physical Training...........	640	–	2	–	2
Statics.....................	20	2	–	2	–
Surveying..................	710, 712	1	4	–	–
Technical English...........	610	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	228	–	14	–	13
Economics and Finance	311	1	–	1	–
Electrical Measurements	332, 334	2	3	2	3
Engineering Problems and Drawing	289	–	3	–	6
Fuels and Combustion	531	1	–	1	–
Geology and Ore Deposits	385, 386	1	1	1	1
Heat Engines, Elementary	420	1	–	–	–
Inorganic Chemistry A	223	1	–	–	–
Inorganic Chemistry B	224	–	–	1	–
Mechanics of Materials	23	2	–	2	–
Metallurgy, Elementary	530	–	–	1	–
Mining	167, 168	1	–	1	–
Physical Training	640	–	2	–	2

THIRD YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Currents	340	1	–	1	–
Analytical Chemistry	225	1	–	1	–
Analytical Chemistry Laboratory	239	–	–	–	6
Assaying	160, 161	1	3	–	3
Cements and Concrete	35	1	–	–	–
Electrical Laboratory	348	–	3	–	3
Electrochemistry	246, 247	2	3	–	–
Engineering Chemistry	240	1	–	1	–
Engineering Problems and Drawing	296	–	3	–	–
Heat Engines, General	422	1	–	1	–
Heat Engines, Theory	427, 428	1	–	1	3
Metallography Laboratory	537	–	3	–	–
Metallurgy	534, 535	2	3	1	6
Ore Dressing	175, 176	1	–	1	6
Physical Metallurgy	536	1	–	1	–
Physics of Ore Dressing	181	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	162, 163	–	–	1	3
Contracts and Specifications	315	–	–	1	–
Electrochemistry	255, 256	2	–	2	6
Engineering Economics	313	–	–	1	–
Hydraulic Laboratory	441	–	–	–	3
Machine Design	469, 470	1	–	1	3
Metallography Laboratory	544	–	3	–	3
Metallurgy	542	1	–	1	–
Metallurgy Problems	540, 541	2	–	2	–
Ore Dressing	177, 178	1	6	1	–
Physical Metallurgy	543, 545	2	3	1	–
Plant Management	317	–	–	1	–
Thesis	736	–	6	–	6

FIRST YEAR SUBJECTS DEPT 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or	500	3	–	4	–
Analytical Geometry and	492	1	–	2	–
Calculus	490	2	–	2	–
Business	310	–	–	1	–
Descriptive Geometry	270	1	–	1	–
Dynamics	21	2	–	2	–
Electricity	330	2	–	2	–
Engineering Problems and Drawing	283	–	3	–	3
General Chemistry	221	2	–	1	–
Inorganic Chemistry Laboratory	222	–	9	–	15
Mineralogy, Elementary	580, 584	2	1	–	–
Physical Training	640	–	2	–	2
Statics	20	2	–	2	–
Surveying	710, 712	1	4	–	–
Technical English	610	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	229	–	10	–	8
Economics and Finance	311	1	–	1	–
Elementary Machine Design	462	1	–	1	–
Electrical Measurements	332, 334	2	3	2	3
Engineering Chemistry	230	1	–	–	–
Engineering Problems and Drawing	290	–	7	–	3
Geology and Ore Deposits	385, 386	1	1	1	1
Hydrostatics	447	–	–	1	–
Industrial Chemistry	231	1	–	1	–
Industrial Chemistry Laboratory	232	–	–	–	5
Inorganic Chemistry A	223	1	–	–	–
Inorganic Chemistry B	224	–	–	1	–
Mechanics of Materials	23	2	–	2	–
Metallurgy, Elementary	530	–	–	1	–
Organic Chemistry	250	1	–	1	–
Physical Chemistry	236	2	–	2	–
Physical Training	640	–	2	–	2

THIRD YEAR SUBJECTS DEPT. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating Currents	340	1	–	1	–
Analytical Chemistry	225	1	–	1	–
Ceramics	562	–	–	2	–
Chemical Engineering	242	1	–	1	–
Electrical Laboratory	349	–	–	–	3
Engineering Chemistry	240	1	–	1	–
Engineering Problems and Drawing	297	–	3	–	3
Heat Engines, Theory	421, 428	2	–	2	1½
Industrial Chemistry Laboratory	238	–	13	–	3
Metallurgy	532	1	–	1	–
Non-metallic Minerals	560	4	–	2	–
Non-metallic Minerals Laboratory	561	–	6	–	9
Petrography, Elementary	587	1	–	–	1
Physical Metallurgy	533	–	–	2	–
Theory of Structures	29	1	–	1	–

FOURTH YEAR SUBJECTS DEPT. 8a	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Ceramic Calculations	563	1	–	–	–
Economic Geology	402	–	–	2	–
Glass and Enamels	566	1	–	1	–
Hydraulics	440, 441	2	3	2	–
Industrial Management	318	1	–	1	–
Industrial Minerals Laboratory	568	–	6	–	6
Machine Design	469, 470	1	–	1	3
Non-metallic Minerals Laboratory	564	–	6	–	3
Non-metallic Mineral Products	567	1	–	1	–
Ore Dressing Laboratory	180	–	3	–	3
Petrography, General	590, 591	1	2	1	2
Physics of Ore Dressing	181	1	–	1	–
Plant Design	300	–	3	–	–
Refractories and Ceramic Bodies	565	2	–	1	–
Silicate Chemistry	257	2	–	–	–
Thesis	737	–	3	–	6

DEPARTMENT OF MINING GEOLOGY
(DEPT. 9)

The course in Mining Geology is designed to train more particularly those who wish to enter the field of applied geology, but it is sufficiently broad to provide training for work in any branch of geology, unless it be in that in which an extensive knowledge of palaeontology is necessary.

The economic geologist is frequently brought into contact with engineering problems and it is essential that he receive a good grounding in those subjects, such as mathematics, mechanics, chemistry, physical sciences, surveying, and engineering drawing, that constitute the preliminary work in engineering courses. It is necessary that he understand something of the language and methods of the mining, metallurgical, and construction engineer with whom he must co-operate in his work around mines, dams, and other engineering works. The first two years of this course are the same as those in Mining Engineering, since that course provides the essential preliminary work, and some mining and metallurgy are taken in the other years to broaden the knowledge of the geologist in the work of those with whom he must co-operate.

A candidate for a degree in Mining Geology will be required to submit satisfactory evidence that he has spent at least six months in field work. This work may consist of prospecting, work around mines, or service on geological field parties.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subject referring to a more detailed description of each, *e.g.*, Analytical Geometry, 492, page 123.

FIRST YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mathematics or....	500	3	–	4	–
Analytical Geometry and.....	492	1	–	2	–
Calculus...............	490	2	–	2	–
Business...................	310	–	–	1	–
Descriptive Geometry........	270	1	–	1	–
Dynamics..................	21	2	–	2	–
Electricity..................	330	2	–	2	–
Engineering Problems and Drawing...............	270	–	9	–	12
General Chemistry..........	220	2	–	1	–
Mineralogy.................	581, 583	2	1	–	1
Mining Laboratory..........	165	–	–	–	3
Petrography, Elementary.....	588	–	–	1	1
Physical Training...........	640	–	2	–	2
Problems and Seminar.......		–	3	–	3
Statics.....................	20	2	–	2	–
Surveying..................	710, 712	1	6	1	–
Technical English...........	610	1	–	1	–

SECOND YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory..................	226, 227	–	6	–	6
Descriptive Geometry........	272	1	–	1	–
Economics and Finance......	311	1	–	1	–
Electricity..................	331, 350	1	–	1	3
Engineering Problems and Drawing..............	285	–	3	–	10
General Geology............	388, 389	2	–	1	2
Heat Engines, Elementary....	420	1	–	–	–
Inorganic Chemistry A.......	223	1	–	–	–
Inorganic Chemistry B.......	224	–	–	1	–
Mechanics of Materials......	23	2	–	2	–

SECOND YEAR SUBJECTS DEPT. 9—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Metallurgy	530	–	–	1	–
Mineralogy	589	–	2	–	2
Mining	167, 169	1	3	–	–
Physical Training	640	–	2	–	2
Problems and Seminar		–	3	–	3
Surveying	715, 716	1	6	1	–
Theory of Measurements	182	1	–	–	–

THIRD YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	225, 237	1	6	1	3
Assaying	160, 161	1	3	–	3
Economic Geology	398, 400	1	3	3	3
Geological Field Work	380	–	–	–	–
Historical Geology	383, 384	2	3	2	3
Metallurgy	532	1	–	1	–
Mining	170	1	–	1	–
Petrography, General	590, 591	1	2	1	2
Physical Chemistry	236	2	–	2	–
Physics of Ore Dressing	181	1	–	1	–
Structural Geology	390, 391	2	3	–	3
Survey Camp	718	–	–	–	–

FOURTH YEAR SUBJECTS DEPT. 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Engineering Economics	313	–	–	1	–
Field Methods	395	–	3	–	3
Geology of Canada	403, 404	2	–	2	3
Geology, Mining	393, 394	2	3	2	3
Geology, Pleistocene and Physiographic	381, 397	1	1	1	–
Geology, Precambrian	392	2	–	–	–
Geophysics	670, 671	2	6	2	6
Mineralography	593	–	2	–	2
Mining	171	1	–	1	–
Optical Mineralogy Laboratory	592	–	2	–	2
Silicate Chemistry	257	2	–	–	–
Thesis	738	–	6	–	6

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 20. Applied Mechanics—Statics, means the course of lectures indicated by this number in the table of curriculum for the First Year on page 26.

AERONAUTICS

1. Aircraft. T. R. Loudon.

Departments 1d and 5h, III Year; 1 hr. lecture per week, both terms.

This is an introductory course in which the various types of aircraft and their component parts are described. The principles of flight are gone into and an elementary discussion of aerodynamic forces and coefficients is given.

Text book: Technical Aerodynamics—Wood.

2. Aircraft Laboratory. T. R. Loudon.

Departments 1d and 5h, III Year; 3 hrs. laboratory per week, second term.

In this course an introduction to advanced aeroplane structural analysis is given and problems illustrating these principles are worked out in the laboratory.

3. Aerodynamics. T. R. Loudon.

Departments 1d and 5h, IV Year; 1½ hrs. lectures per week, both terms.

This course of lectures extends the theory of hydrodynamics to the case of theoretical determination of forces resulting from flow around an airfoil. The theory of model testing and scale effect is discussed and a complete analysis is made of conditions of longitudinal and lateral stability. The problem of the lighter than air craft is also discussed.

Text books: Aerofoil and Airscrew Theory—Glauert. Technical Aerodynamics—Wood.

4. Aerodynamics Laboratory. T. R. Loudon, R. B. McIntyre.

Department 1d, IV Year; 3 hrs. laboratory per week, both terms.

Department 5h, IV Year; 6 hrs. laboratory per week, both terms.

This course is intended to amplify the lecture courses on hydrodynamics and aerodynamics. The calibration and practical use of wind tunnel instruments are explained, and a series of experiments is carried out on the determination of forces and moments acting on various airfoil arrangements.

5. Airplane Design. T. R. Loudon.

Departments 1d and 5h, IV Year; 2 hrs. lectures per week, both terms.

The methods of application of aerodynamic theory and stress analysis to the design of airplanes are gone into in this course of lectures. Problems are set for the laboratory periods in which actual airplane layouts are made and stressed for the required conditions in practice.

Text books: Technical Aerodynamics—Wood. Air Ministry Publications 970 and 1208.

6. Airplane Design Laboratory. T. R. Loudon.

Departments 1d and 5h, IV Year; 9 hrs. laboratory per week, both terms.

In this course, the principles from the various lecture courses on aerodynamics and stress analysis are applied to the design of an aeroplane as a whole, and to its component parts. The actual British Air Ministry conditions used in Canada are applied to these design problems.

7. Airplane Stress Analysis. T. R. Loudon.

Departments 1d and 5h, IV Year; 1½ hrs. lectures per week, both terms.

This course of lectures deals with the special analysis required for aircraft members such as struts with side loads, continuous beams with axial loads, etc. The question of stability is gone into thoroughly for individual members, framed structures, and stressed skin construction. Tension coefficients, strain-energy analysis, and various analytical and graphical methods are also discussed.

Text book: Airplane Structures—Niles and Newell.

8. Hydrodynamics. R. B. McIntyre.

Department 1d, IV Year; 2 hrs. lectures per week, both terms.

The course of lectures reviews the theory of the aerofoil in three dimensions and proceeds to a discussion of the airscrew on both the momentum and blade element bases. The lectures deal at greater length with the performance of the aeroplane as a whole as regards speed, control, and manoeuvreability. The equations of motion for aircraft are discussed, with particular reference to stability in straight flight. The spin is also discussed.

APPLIED MECHANICS AND DESIGN OF STRUCTURES

20. Applied Mechanics—Statics. T. R. Loudon.

Departments 1, 2, 3, 4, 6, 7, 8, 8a, and 9, I Year; 2 hrs. lectures per week, both terms.

This course of lectures deals with the fundamental principles of

the laws of equilibrium of forces. These principles are applied to the determination of stresses in simple structures. Toward the end of the course an introduction to Mechanics of Materials is given.

Text book: Analytical Mechanics for Engineers—Seely and Ensign.

21. Applied Mechanics—Dynamics. M. J. C. Lazier.

Departments 1, 2, 3, 6, 7, 8, 8a, and 9, I Year; 2 hrs. lectures per week, both terms.

This course of lectures is designed to extend the elementary principles of preparatory school mechanics to a more general viewpoint. Under the heading of kinematics, the general equations of motion, both linear and angular, are developed.

Centres of mass and moments of inertia are calculated.

The principles of linear and angular momentum are dealt with and a fairly comprehensive course on effective and inertia forces as applied to engineering problems is given. The discussion of energy, work, and power is extended as far as possible to practical problems.

Simple harmonic motion is also discussed.

Text books: Tutorial Dynamics—Briggs and Bryan. Analytical Mechanics for Engineers—Seely and Ensign. Introduction to Mechanics—J. W. Campbell.

22. Applied Mechanics—Dynamics. T. R. Loudon, M. J. C. Lazier.

Department 3, II Year; 1 hr. lecture per week, both terms.

This course of lectures extends the work of the First Year to more general applications, such as: bodies moving with general plane motion, compound pendulum, gyroscopic action. A short discussion of the fundamental theory of hydrodynamics with particular reference to determining stream line flow is included in these lectures.

Text books: Analytical Mechanics for Engineers—Seely and Ensign. Hydromechanics, Part II—Ramsey.

23. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Departments 1, 2, 3, 6, 7, 8, 8a, and 9, II Year; 2 hrs. lectures per week, both terms.

In this course, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Reference book: Strength of Materials—Case.

24. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Department 5, II Year; 2 hrs. lectures per week, both terms.

In this course the fundamental theories of stress and strain are discussed and applied to the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. One portion of the course deals with dynamics of rigid bodies, general equations in two dimensions, centre of percussion, the compound pendulum, friction, and simple harmonic motion with friction.

Reference book: Strength of Materials—Case.

25. Applied Mechanics—Mechanics of Materials. T. R. Loudon, M. J. C. Lazier.

Department 4, II Year; 2 hrs. lectures per week, both terms.

This course deals with the mathematical consideration of stress and elasticity. Among the problems taken up are the consideration of riveted joints, theory of simple and continuous beams, the theory of columns and simple column footings.

Text book: Strength of Materials—Boyd.

26. Applied Mechanics—Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Department 5, I Year; 2 hrs. lectures per week, both terms.

This course of lectures deals with the determination of stresses in simple frame structures and beams. The course also includes a discussion of kinematics of particles, accelerated motion, motion on curved paths, the kinematic chain, geometry of simple harmonic motion, kinetics of massive particles, momentum, collision, rotation, moments of inertia, energy, work, power, kinetics of simple harmonic motion, and Bernoulli's equation.

Text book: Analytical Mechanics for Engineers—Seely and Ensign.

27. Applied Mechanics—Advanced Engineering Mechanics. T. R. Loudon, M. J. C. Lazier.

Departments 1c, 1d and 5, III Year; 1 hr. lecture per week, both terms.

This course of lectures deals with accelerations in machines, balancing governors, gyrostatic action, generalized equations, stability of motion, and vibrating systems.

28. Theory of Structures. C. F. Morrison.

Department 1, III Year; 2 hrs. lectures per week, both terms.

This course is an elementary study of the stress analysis and design of structures, structural members, and their details. Problems in analysis and design are worked out in the lectures and in the drafting room.

The work in the first term includes a discussion of tension members, steel and timber columns, simple and continuous beams, box girders, and plate girders. Welding as a method of connecting structural steel members is studied.

The second term is given chiefly to moving loads, the design of a riveted truss highway span, and the theory of railway truss spans.

Text books: Modern Framed Structures, Part III—Johnson, Bryan and Turneaure. Structural Members and Connections—Hool and Kinne. Elementary Structural Problems—Young. Structural Design in Steel—Shedd. Steel Construction Handbook—A.I.S.C.

29. Theory of Structures. C. F. Morrison.

Departments 2, 3, 5h, 6, and 8a, III Year; 1 hr. lecture per week, both terms.

The work is practically the same as that for course 28 in the first term.

30. Structural Design. C. F. Morrison.

Department 4, III Year; 1 hr. lecture and 3 hrs. problems per week, both terms.

The stress analysis of simple structures is discussed in this course. Practical problems on the design of beams, columns, piers, footings, and roof trusses are worked out in the drafting room. Some time is spent testing and determining the physical properties of structural materials.

Reference books: Architectural Construction—Gay and Parker. Design of Steel Buildings—Hauf.

31. Mechanics of Materials. C. R. Young, W. L. Sagar.

Departments 3 and 5, II Year; Department 2, IV Year; 3 hrs. laboratory per week, second term.

Department 1, III Year, 5 hrs. laboratory per week, first term.

This laboratory course is intended to give the student an introduction to the experimental study of the strength and elasticity of materials. It is intended that he shall acquire some familiarity with the construction and operation of testing machines and with the properties of ordinary materials of construction. In addition students in Department 1 conduct a series of experiments designed to give familiarity with the fundamentals of concrete mixtures.

Reference book: Junior Laboratory Course in Mechanics of Materials, Department of Civil Engineering; Municipal and Structural.

32. Graphical Methods. R. F. Legget.

Department 1, III Year; 1 hr. lecture per week, both terms.

This course of lectures deals with graphic methods of determining

stresses in framed structures, the construction of shearing force diagrams, bending moment diagrams, and influence lines. Some attention is also given to the principles of formula charting.

Text book: Graphic Analysis—Wolfe.

33. Applied Elasticity. C. F. Morrison.

Department 1, III Year; 1 hr. lecture per week, both terms.

This course is a study of the stresses and strains in structural materials and members. The topics treated include: members subjected to direct stress, shear stress, and flexural stress, and their resulting deformations; principal stresses; statically indeterminate structures such as continuous and fixed-end beams; the moment-area theorems; photo-elasticity as a method of determining stress intensity.

Reference books: Elements of Strength of Materials—Timoshenko and MacCullough. Applied Elasticity—Timoshenko and Lessells.

34. Applied Elasticity. C. F. Morrison.

Department 1c, IV Year; 1 hr. lecture and 3 hrs. problemns per week, both terms.

A study of the deformations and stresses in the following: plates and slabs loaded and supported in various ways; beams on elastic foundations; footings; heads of pressure vessels; balls and rollers subjected to compressive forces. Problems based on the work covered in the lectures are worked out in the drafting room. Some problems are solved experimentally by the photo-elasticity method and some with the Beggs' deformeter apparatus.

Reference book: Applied Elasticity—Timoshenko and Lessells.

35. Cements and Concrete. C. F. Morrison, W. L. Sagar.

Department 1, III Year; 1 hr. lecture per week, both terms.

Department 8, III Year; 1 hr. lecture per week, first term.

The work in the first term includes a discussion of the cements used in construction, Portland cement in particular, and a study of the basic principles of concrete making.

In the second term the elements of the theory of reinforced concrete are discussed and examples are considered in the design of slabs, beams, and columns.

Text books: Plain Concrete—Bauer. Chemistry of Cement and Concrete—Lea and Desch. Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete Construction, Vol. I—Hool. Design of Concrete Structures—Urquhart and O'Rourke.

36. Theory of Structures. C. R. Young.

Departments 1a, 1c, and 1d, IV Year; 2 hrs. lectures per week, both terms.

The work comprised in this course of lectures concerns arches, suspension bridges, cantilever bridges, movable bridges, deflections, statically indeterminate systems, and secondary stresses. Problems based on the lectures are worked out in the drafting rooms.

Reference books: Modern Framed Structures, Part II—Johnson Bryan and Turneaure. Theory of Modern Steel Structures, Vol. II—Grinter.

37. Advanced Structural Analysis. C. R. Young, C. F. Morrison.

Department 1c, IV Year; 2 hrs. lectures per week, second term.

Flexural deformations are thoroughly investigated by the methods of single and double integration, by moment areas, shear areas, elastic weights, dummy loads, and Castigliano's first theorem. This is followed by a consideration of shear deformations, space structures, applications of the slope-deflection method and modifications of it, applications of the method of moment distribution, with modifications, stress determination by the method of least work, by Castigliano's second theorem, and by the column analogy method.

38. Mechanics of Materials. C. R. Young, W. L. Sagar.

Departments 1a, 1c and 1d, IV Year; 3 hrs. laboratory per week, both terms.

This course of experiments is intended to give the student practice in investigating the elastic and physical properties of iron, steel, concrete, timber, etc., and in the use of instruments of precision designed for that purpose.

Reference book: Materials of Construction—Johnson.

39. Foundations, Retaining Walls, and Dams. W. J. Smither, R. F. Legget.

Departments 1a, 1c, and 1d, IV Year; 1 hr. lecture per week, both terms.

This course of lectures is devoted to the design of the structures mentioned. The most approved forms of construction of retaining walls, footings, abutments, piers, and dams are described, and typical designs are worked out in the class and drafting rooms.

Text books and reference books: Retaining Walls for Earth—M. A. Howe. Walls, Bins and Grain Elevators—M. S. Ketchum. Design and Construction of Dams—E. Wegmann.

40. Soil Mechanics. W. L. Sagar.

Department 1a, IV Year; 1 hr. lecture per week, first term.

A course of lectures devoted to those physical and mechanical properties of soils of importance to the engineer, such as compressive

and cohesive strengths, internal friction, stability in slopes, compressibility and other deformational characteristics, permeability and moisture retention. The bearing of these properties on the design and construction of engineering works is considered in detail.

Reference books: Engineering Properties of Soil—Hogentogler. Notes on Soil Mechanics and Foundations—Plummer.

41. Reinforced Concrete. C. R. Young.

Departments 1a, 1c, and 1d, IV Year; 1 hr. lecture per week, both terms.

The theory of the strength of reinforced concrete elements, including the beam, the slab, the T-beam, the column, and the girderless floor, is continued in this course.

The analysis of the monolithic arch by the elastic theory is discussed, and the student is required in the drafting room to apply his knowledge to the design of simple structures.

Reference books: Principles of Reinforced Concrete Construction—Turneaure and Maurer. Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete—Caughey.

42. Structural Design. C. F. Morrison.

Department 4, IV Year; 1 hr. lecture and 3 hrs. problems per week, both terms.

In this course the properties of the materials used and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of slabs, beams, columns, and footings are made. The lectures are supplemented by problems assigned in the drafting room. Some time is spent on the design and testing of concrete mixtures.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Architectural Construction—Gay and Parker.

43. Structural Design. C. R. Young, W. J. Smither.

Departments 1a and 1c, IV Year; 1 hr. lecture per week, both terms.

Department 3, IV Year; 1 hr. lecture per week, first term.

In this course of lectures consideration is given to such matters as mill construction buildings, economic arrangement of building frames, probable loadings for girders and columns, column eccentricities, crane runways, cableways, wind bracing, and rigid frames.

Text books: Handbook of Building Construction—Hool and Johnson. Architects' and Builders' Handbook—Kidder-Parker.

44. Structural Design. W. J. Smither, C. F. Morrison.

Departments 1a, 1c, and 3, IV Year; 1 hr. lecture per week, first term.

Consideration is given in this course to the various types of mill buildings, the conditions governing their choice, and to the design and details of construction in different materials. Designs of portions of mill buildings are worked out in the class and drafting rooms.

Text books: Steel Mill Buildings—Ketchum. Mill Buildings—Tyrrell.

45. Miscellaneous Structures. W. J. Smither.

Departments 1a and 1c, IV Year; 1 hr. lecture per week, second term.

In this course of lectures the application of theoretical principles to the design of a variety of structures is made. Among those structures discussed are transmission line towers, elevated tanks and their supporting towers, standpipes, large pressure pipes, sewers, culverts, small highway bridges, sub-surface tanks, aircraft structures and tall chimneys. Whenever possible the lecture work is followed up by designs in the drafting room.

46. Reinforced Concrete. C. F. Morrison.

Department 3, IV Year; 1 hr. lecture per week, first term.

In this course the properties of the materials involved and the elements of the theory of reinforced concrete are studied. Applications of this theory to the design of columns, beams, floors, and footings are made.

Reference books: Reinforced Concrete Design—Sutherland and Clifford. Reinforced Concrete Construction, Vol. I—Hool. Design of Concrete Structures—Urquhart and O'Rourke.

47. Structural Design. C. F. Morrison, R. F. Legget.

Department 4, V Year; 1 hr. lecture and 3 hrs. problems per week, both terms.

The lectures in this course in the first term are the same as those for course 39, and deal with the design of foundations. In the second term some of the more advanced work in reinforced concrete is studied, including flat slab construction, panels reinforced in two directions, rigid frames and arches. In the drafting room the students apply the principles of structural design to problems in which actual buildings are designed and detailed.

48. Vibration Engineering. M. J. C. Lazier.

Department 1c, IV Year; 1 hr. lecture per week, both terms.

Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

49. Vibration Laboratory. M. J. C. Lazier.
Department 1c, IV Year; 3 hrs. laboratory per week, both terms.
A series of experiments designed to give familiarity with the nature of vibrating systems and the causes, measurement, and control of vibration in engineering problems.

APPLIED PHYSICS

70. Applied Physics. V. L. Henderson.
Departments 3 and 7, I Year; 1 hr. lecture per week, both terms.
A course of lectures on the production and distribution of light, photometry and illumination, optics and optical instruments.

71. Applied Physics Laboratory. V. L. Henderson.
Departments 3 and 7, I Year; 3 hrs. laboratory per week, both terms.
A laboratory course supplementing course 70, including instructions in the theory of measurement; the use of the slide rule, nomogram, graph, and written report. A certain amount of laboratory time is also allotted to library work and supplementary reading on specified subjects.

72. Optics. K. B. Jackson.
Department 6, I Year; 1 hr. lecture per week, both terms.
A course of lectures on light, geometrical and physical optics, and optical instruments pertaining to chemical engineering.

Optics, see Course 660.

73. Optics Laboratory. L. E. Jones, W. A. Mohun.
Department 6, I Year; 3 hrs. laboratory per week, first term.
A laboratory course supplementing course 72, including instructions in the theory of measurement; the use of the slide rule, nomogram, graph, and written report. A certain amount of laboratory time is also allotted to library work and supplementary reading on specified subjects.

74. Optics Laboratory. L. E. Jones, W. A. Mohun.
Department 6, II Year; 1 hr. laboratory per week, second term.
A continuation of laboratory course 73, on optical instruments in chemical engineering.

75. Applied Physics. K. B. Jackson.
Department 1, I Year; 1 hr. lecture per week, both terms.
A course of lectures on optics and optical instruments, photography, and stereoscopy; the projection of light and its applications.

76. Applied Physics Laboratory. L. E. Jones, W. A. Mohun.
Department 1, I Year; 3 hrs. laboratory per week, both terms.
A laboratory course supplementing course 75, including instructions in the theory of measurement; the use of the slide rule, nomogram, graph, and written report. A certain amount of laboratory time is also allotted to library work and supplementary reading on specified subjects.

77. Photography. L. E. Jones.
Department 4, II Year; 1 hr. lecture per week, both terms.
A course of lectures on the principles of photography, photographic equipment, materials, and processes, with special reference to architectural photography and an outline of the photo-mechanical processes.

78. Photography Laboratory. L. E. Jones.
Department 4, II Year; 3 hrs. laboratory per week, both terms.
A laboratory course supplementing course 77.

79. Photography Applied to Research. K. B. Jackson.
Senior and graduate students; 1 hr. lecture per week, both terms.
A course of lectures on the principles of photography, the choice and use of equipment for special purposes, the photometry of projection, sensitometry, and the correct use of photographic materials and processes.

80. Photography Laboratory. K. B. Jackson, D. H. Hamly.
Senior and graduate students; 2 hrs. laboratory per week, both terms.
A laboratory course supplementing course 79.

81. Photographic Surveying. K. B. Jackson, W. M. Treadgold.
Department $1a_2$, IV Year; 3 hrs. lectures per week, first term; 2 hrs. lectures per week, second term.
A course of lectures on the photographic processes involved, the calibration of surveying cameras, the stereoscopic examination of photographs, and methods of plotting in ground and aerial photographic surveying.

82. Photographic Surveying Laboratory. K. B. Jackson, W. M. Treadgold.
Department $1a_2$, IV Year; 3 hrs. laboratory per week, both terms.
A laboratory course supplementing course 81.

83. Photographic Surveying. K. B. Jackson, W. M. Treadgold.
Department 1b, IV Year; 1 hr. lecture per week, both terms.
A short course of lectures on the subject matter of course 81.

84. Photographic Surveying Laboratory. K. B. Jackson, W. M. Treadgold.
Department 1b, IV Year; 2 hrs. laboratory per week, both terms.
A laboratory course supplementing course 83.

85. Light and Acoustics. V. L. Henderson.
Department 4, III Year; 1 hr. lecture per week, both terms.
A course of lectures on the production and propagation of sound, the control of reverberation, sound transmission through partitions, and vibration insulation; and an elementary course in the production of light, and the measurement of light and electricity, in preparation for course 87.

86. Light and Acoustics Laboratory. V. L. Henderson.
Department 4, III Year; 2 hrs. laboratory per week, both terms.
A laboratory course supplementing course 85.

87. Illumination Design. V. L. Henderson.
Department 4, IV Year; 1 hr. lecture per week, both terms.
A course of lectures on the control of light distribution, the computation of illumination and brightness, and the design of lighting installations for public and private buildings.

88. Illumination Design Laboratory. V. L. Henderson.
Department 4, IV Year; 1 hr. laboratory per week, both terms.
A laboratory course supplementing course 87. By co-operation with the staff of the School of Architecture, problems in lighting design and acoustics will form a part of certain problems in architectural design in courses 123, 124, and 125.

89. Architectural Acoustics. V. L. Henderson.
Department 5i, IV Year; 1 hr. lecture per week, first term; 3 hrs. lectures per week, second term.
A course of lectures on the design of buildings for good acoustics, on the calculation and measurement of the acoustical properties of buildings and materials, and on the treatment of buildings to improve their acoustical properties and to control the nuisance of noise.

90. Architectural Acoustics Laboratory. V. L. Henderson.
Department 5i, IV Year; 3 hrs. laboratory per week, first term; 9 hrs. laboratory per week, second term.
A laboratory course supplementing course 89.

91. Photometry. K. B. Jackson, V. L. Henderson.
Department 7i, IV Year; 3 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

A course of lectures on the production, distribution, and measurement of light and colour, the theory and application of visual and physical photometers, and the photometry of projection equipment.

92. Photometry Laboratory. K. B. Jackson, V. L. Henderson.
Department 7i, IV Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.
A laboratory course supplementing course 91.

93. Illumination Design. K. B. Jackson, V. L. Henderson.
Department 7i, IV Year; 2 hrs. lectures per week, second term.
A course of lectures on the theory and design of lighting equipment and installations, with due regard to the visual task and the architectural features involved.

94. Illumination Design Laboratory. K. B. Jackson, V. L. Henderson.
Department 7i, IV Year; 3 hrs. laboratory per week, second term.
A laboratory course supplementing course 93 devoted to lighting calculations and the solution of specific design problems.

95. Photometry and Illumination Design. K. B. Jackson, V. L. Henderson.
Department 5i, IV Year; 2 hrs. lectures per week, both terms.
A course of lectures on measurements of luminous intensity, luminous flux, illumination, brightness, reflection, transmission, absorption, diffusion, and colour by visual and physical methods; and on the design and application of illuminating engineering equipment.

96. Photometry and Illumination Design Laboratory. K. B. Jackson, V. L. Henderson.
Department 5i, IV Year; 6 hrs. laboratory per week, both terms.
A laboratory course supplementing course 95.

ARCHITECTURE, DRAWING, AND PAINTING

110. History of Architecture. H. J. Burden.
Department 4, I Year; 1 hr. lecture per week, both terms.
In this course the development of architecture and ornament is traced from pre-historic times to the close of the Byzantine Period.
Reference books: A Short Critical History of Architecture—H. Heathcote Statham. The Architecture of Ancient Greece—Anderson, Spiers, and Dinsmoor. The Architecture of Ancient Rome—Anderson, Spiers, and Ashby. The Grammar of Ornament—Owen Jones.

111. History of Architecture A. H. J. Burden.

Department 4, II Year; 1 hr. lecture per week, both terms.

In this course the development of architecture and ornament is traced from the Romanesque Period to the end of the Gothic Period.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. Medieval Architecture—Arthur Kingsley Porter. Gothic Architecture in England—Francis Bond. The Grammar of Ornament—Owen Jones.

112. History of Architecture A. H. H. Madill.

Department 4, III Year; 1 hr. lecture per week, first term.

In this course the architecture of the Renaissance in Italy and France is taken in detail.

Reference books: A Short Critical History of Architecture—H. Heathcote Statham. Architecture of the Renaissance in Italy—Anderson and Stratton. The Architecture of the Renaissance in France, Vols. I and II—W. H. Ward. The Renaissance of Roman Architecture—T. G. Jackson.

113. History of Architecture B. E. R. Arthur.

Department 4, III Year; 1 hr. lecture per week, second term.

This course of lectures covers the period 1500-1900 in England. Lectures on furniture are given in this course with special reference to the development of furniture in England from Mediaeval times.

Reference books: Growth of the English House—J. Alfred Gotch. A History of Renaissance Architecture in England, Vol. 1 and 2—R. Blomfield. History of Domestic Architecture in Britain during the Tudor Period—Thomas Garner and Arthur Stratton. Houses of the Wren and Early Georgian Period—Tunstall Small and Christopher Woodbridge. Mouldings of Wren and Georgian Periods—T. Small and C. Woodbridge. Robert Adam and his Brothers—John Swarbrick.

114. Functional Requirements of Buildings. A. S. Mathers.

Department 4, III Year; 1 hr. lecture per week, both terms.

In this course of lectures the principles underlying the planning of residence and farm buildings, and such larger buildings as churches, theatres, schools, industrial buildings, hospitals, etc., are discussed in detail.

115. Functional Requirements of Buildings. A. S. Mathers.

Department 4, IV Year; 1 hr. lecture per week, both terms. A continuation of course 114.

116. Garden Design. H. B. Dunington Grubb.

Department 4, III, IV, and V Years; Special lectures, first term.

In this course the historical development of Garden Design is traced from earliest times; the study of sites; the influence of topography, orientation, access, etc., on the problems of design; site planning; the location of buildings; the solution of an actual problem on a typical site.

117. Town Planning and Housing. H. S. M. Carver.

Department 4, V Year; 2 hrs. lectures per week, second term.

The organization of the modern city is described in preliminary lectures, after which analytical studies of certain urban functions are made by the students. This is followed by a design project for the plan of a community on an actual site, the programme for which is developed in seminar.

118. Elements of Architectural Form. E. R. Arthur.

Department 4, I Year; 1 hr. lecture per week, both terms.

The elements of architectural form include the study of doors, windows, columns, wall treatment, roofs, mantels, chimney stacks, etc. These are examined without regard to particular style and from the standpoint of design rather than construction.

Reference books: Theory and Elements of Architecture, Vol. I, Part 1—Robert Atkinson and Hope Bagenal. Fragments Antique, Vol. I and II—D'Espouy. The English Fireplace—L. A. Shuffrey. The Design of Lettering—Egon Weiss. Current Architectural Magazines.

119. History of Painting. C. W. Jefferys.

Department 4, IV Year; 1 hr. lecture per week, both terms.

The course consists of an outline of the history and development of painting and of the minor pictorial arts from the earliest time until the present day.

120. History of Sculpture. P. H. Brieger.

Department 4, III Year; 1 hr. lecture per week, first term.

A course of lectures on the history of architectural sculpture, including the modern.

121. Architectural Design. H. H. Madill, E. R. Arthur, W. E. Carswell.

Department 4, I Year; 14 hrs. studio per week, first term; 17 hrs. studio per week, second term.

This comprises work done in the studio, including lettering, drawing, and rendering such elementary studies as a door, a window, etc., and exercises in simple composition.

An elementary design is carried to the stage of working drawings. Furniture, mantels, etc., in the Royal Ontario Museum are drawn to scale.

122. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4, II Year; 18 hrs. studio per week, both terms.

This course is given by means of individual instruction in the studio, and by criticism of the solutions of different problems set during the year. It is in this course that the student begins the serious study of design; continued practice in architectural drawing and rendering affords the training necessary to make the student a proficient draughtsman.

123. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4, III Year; 20 hrs. studio per week, first term; 22 hrs. studio per week, second term.

This course is given by individual instruction in the studio and by criticism of solutions of problems set during the year. The greater part of the course is devoted to problems in design and forms a continuation of the course given in the preceding year.

One of the students' designs of a building is carried through to the stage of working drawings.

124. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4l, IV Year; 20 hrs. studio per week, both terms.

This course is a continuation of the work of the preceding years, being given by individual instruction in the studio and criticisms of the solution of problems set during the year.

125. Architectural Design. E. R. Arthur, H. J. Burden, Mackenzie Waters.

Department 4l, V Year; 26 hrs. studio per week, both terms.

The course of the preceding year is continued in more advanced problems.

One of the students' designs of a building is carried through to the stage of working drawings.

126. Architectural Engineering. H. H. Madill, C. F. Morrison.

Department 4m, IV Year; 1 hr. lecture and 19 hrs. studio per week, both terms.

In this course lectures on structural design and layout are given and problems are worked out in the studio. The work is co-ordinated with problems set in architectural design.

127. Architectural Engineering. H. H. Madill, C. F. Morrison.

Department 4m, V Year; 2 hrs. lectures and 24 hrs. studio per week, both terms.

In this course the design and preparation of working drawings and structural details of work of a comprehensive character are carried on in the studio. The student is also required to take such lectures as are prescribed from time to time. The work is co-ordinated with problems set in architectural design.

128. Theory of Architectural Planning. E. R. Arthur.

Department 4, II Year; 1 hr. lecture per week, both terms.

In this course the general principles of planning of buildings from the small to complex problems are demonstrated. In the second term actual plans of libraries, banks, houses, etc., are studied as an aid to problems in design and a preliminary to work in the following year.

Reference books: Elements of Form and Design in Classic Architecture—Arthur Stratton. The Modern House—F. R. S. Yorke. The Smaller English House of the Later Renaissance, 1660-1830—A. E. Richardson and H. D. Eberlein. The Plan Requirements of Modern Buildings—V. O. Rees.

129. Architectural Composition. E. R. Arthur.

Department 4, III Year; 1 hr. lecture per week, both terms.

This course consists of a series of lectures on the theory of architectural design, the analysis of composition, proportion, scale, etc.

Illustrated lectures are given on modern architecture.

Reference books: Principles of Architectural Composition—Howard Robertson. Modern Architectural Design—Howard Robertson. The Architecture of Humanism—Geoffrey Scott. The Gothic Revival—Kenneth Clark. Towards a New Architecture—Le Corbusier. The Study of Architectural Design—J. F. Harbeson. Architectural magazines from England, France, Italy, Germany, and the United States are available to the students in the School Library.

130. Architectural Aspects of Town Planning. E. R. Arthur.

Department 4, V Year; 1 hr. lecture per week, second term.

The student is made familiar with the plans of actual cities—their growth is studied; and details like public squares and street architecture are examined in relation to the city plan. The work is mainly historical and preparatory to housing and town planning given elsewhere.

131. Freehand Drawing and Water Colour Painting. H. J. Burden, W. E. Carswell.

Department 4, I Year; 2 hrs. studio per week, both terms.

Drawing from still life, primary freehand perspective, primary pencil, charcoal, and pen and ink rendering.

132. Freehand Drawing, Water Colour Painting, and Rendering. H. J. Burden, W. E. Carswell.

Department 4, II Year; 2 hrs. studio per week, both terms.

Drawing and monochrome painting from still life, drawing from the cast, pencil, pen and ink, and monochrome rendering, primary water colour, drawing from landscape and natural objects.

In addition to the periods set out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the Camp on the date shown on page 5.

133. Freehand Drawing, Water Colour Painting, and Rendering. H. J. Burden, W. E. Carswell.

Department 4, III Year; 2 hrs. studio per week, both terms.

Drawing from the cast, water colour from still life, water colour rendering, drawing from landscape and natural objects.

Students who are sufficiently advanced are admitted to the Fourth Year Life Drawing Class.

In addition to the periods set out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the Camp on the date shown on page 5.

134. Freehand Drawing, Water Colour Painting and Rendering. H. J. Burden, W. E. Carswell.

Department 4, IV Year; 2 hrs. studio per week, both terms.

Water colour from still life and from landscape, drawing from life.

In addition to the periods set out above, instruction is given in the studios in rendering (wash, charcoal, and other mediums), as problems in design approach completion.

Students are required to attend a course in field sketching at the University Survey Camp during the last week in September.

Students will report at the Camp on the date shown on page 5.

135. Mural Painting. C. W. Jefferys.

Department 4, V Year; 2 hrs. studio per week, both terms.

Advanced water colour drawings and murals; drawings from life.

136. Colour. H. J. Burden, W. E. Carswell.

Department 4, III Year; 1 hr. lecture per week, first term.

This course is intended to assist the student in an appreciation of the value of colour and its application to architecture. Colour in period and modern rooms, the effect of sunlight and shade on colour, and differences in treatment in domestic, civic and institutional buildings are examined in class and on the boards. Theory of colour is discussed and the student is made familiar with such modern systems as those of Ostwald and Munsell.

137. Modelling. Frederick Coates.

Department 4, II Year; 2 hrs. studio per week, both terms.

Scale models of architectural forms.

138. Modelling. Frederick Coates.

Department 4, III Year; 2 hrs. studio per week, both terms.

Scale models of simple buildings.

139. Modelling. Frederick Coates.

Department 4, IV Year; 2 hrs. studio per week, both terms.

Scale models of buildings and settings.

140. Building Construction. H. H. Madill.

Department 4, I Year; 1 hr. lecture per week, second term.

Instruction is given in elementary construction using common building materials. The detailing of doors, windows, roofs, etc.

Reference books: Architectural Building Construction, Vol. 1—Jaggard and Drury. Building Construction, Vol. I—V. F. Mitchell. Architectural Graphic Standards—Ramsey and Sleeper.

141. Building Materials. H. H. Madill.

Department 4, IV Year; 1 hr. lecture per week, second term.

Properties and the use of the various materials used in building are studied from the architectural rather than the structural viewpoint.

A small exhibition room has been set aside in which examples of the most modern materials and devices are displayed. This room is open to the student at all times.

Reference books: Architectural Construction, Vol. I—Voss and Henry. Builders Materials—R. F. B. Grundy. Brickwork—W. R. Jaggard. Lumber and its uses—R. S. Kellog. Building Construction, Vol. 1 and 2—Jaggard and Drury. Rivingtons Notes on Building Construction, Part I and II—W. N. Twelvetrees.

142. Sanitary Science. H. H. Madill.

Department 4, IV Year; 1 hr. lecture per week, both terms.

Modern plumbing, its design and installation, drainage, sewage disposal and water supply.

Reference books: Mechanical and Electrical Equipment for Buildings—Gay and Fawcett.

143. Professional Practice. H. H. Madill.

Department 4, V Year; 1 hr. lecture per week, both terms.

This course of lectures is designed to give an understanding of the professional character of the practice of architecture. In it are

discussed the ethical, business, and legal relations of the architect to clients, contractors, craftsmen, engineers, and the professional bodies. The methods of office practice are also discussed.

Reference books: Architectural Practice and Procedure—H. H. Turner. The Architects Law Manual—C. H. Blake. The Law of Architecture and Building—C. H. Blake. Handbook of Architectural Practice A.I.A. Contact Forms of R.A.I.C. Engineering Law—Laidlaw and Young. Architects' Specifications—Goldsmith.

144. Heating and Air Conditioning. A. Wardell.

Department 4, V Year; 1 hr. lecture per week, both terms.

In this course of lectures the different systems of heating, ventilating, and air conditioning of buildings are discussed.

145. Architectural Economics. W. S. Wilson.

Department 4, V Year; 1 hr. lecture per week, both terms.

A course of instruction in the various methods of preparing estimates, together with practical work in taking off quantities.

Building finance, revenue, and expenditure are also discussed.

ASSAYING, MINING, AND ORE DRESSING

The work in Mining is designed to give a thorough training in the underlying principles of Mining in its various branches, including exploration, development, and production. Especial attention is paid to the practical and business aspects of these subjects.

The teaching of assaying has a two-fold function. The first is to give the student a working knowledge of the practice of the art, so that he can earn money as an assayer, upon graduation, and use this as a stepping-stone to other positions. The second is to use the assaying laboratories for the training of students in certain important phases of engineering methods. The size of the apparatus, the completeness of the processes in short intervals of time, the extreme accuracy of results when so desired, the relation of the extent of error to time and method, the similarity of the academic laboratory to the field laboratory—all these permit an unrivalled opportunity for driving home much broad engineering philosophy. The assaying processes and apparatus lend themselves peculiarly well to the development of a proper perspective in regard to errors and accuracy in measurements.

The study of ore dressing, when accompanied by laboratory work in a well-equipped ore dressing laboratory, is one of the most important of the mining engineering subjects. Not only is the mechanical treatment of ores a very important branch of mining engineering, but the mental processes involved in a study of the fundamental principles underlying the art, and the compromise necessary for field practice form one of the best fields for the develop-

ment of engineering philosophy. From these points of view, the ore dressing laboratory is exceptionally well equipped.

160. Assaying. J. T. King.

Departments 2, 8, and 9, III Year; 1 hr. lecture per week, first term.

A first course of lectures on the theory of fire assaying. Emphasis is laid not only upon the chemical and metallurgical principles involved, but upon the errors inherent in operators as well as in methods.

Text book: Manual of Fire Assaying—Fulton and Sharwood.

161. Assaying Laboratory. J. T. King.

Departments 2, 8, and 9, III Year; 3 hrs. laboratory per week, both terms.

A laboratory course in the determination of the precious metals in ores, milling, and metallurgical products; scorification and crucible assays of ores and products, pure and impure, fluxes, slags, and solutions; buckboard practice, ores with metallics; copper and lead by electrolysis. Students are expected to do their later assays with despatch and a reasonable degree of accuracy. Neatness of work is required.

162. Assaying. J. T. King.

Departments 2 and 8, IV Year; 1 hr. lecture per week, second term.

A continuation of course 160. Complex ores; combination assays; the sampling and assay of bullion; the platinum group metals; checks and corrections.

163. Assaying Laboratory. J. T. King.

Departments 2 and 8, IV Year; 3 hrs. laboratory per week, second term.

An advanced laboratory course in which some of the methods of course 162 are used.

164. Assaying Laboratory. J. T. King.

Department 6, III Year; 3 hrs. laboratory per week, first six laboratory periods of first term.

An introductory laboratory course for chemical engineers. Some lecture instruction is given. An abbreviation of courses 160 and 161.

165. Mining Laboratory. C. G. Williams, F. C. Dyer.

Departments 2 and 9, I Year; 3 hrs. laboratory per week, second term.

A laboratory course, including some lectures, being an introduction to certain mining and milling machinery and methods.

166. Mining Laboratory. C. G. Williams.

Department 2, IV Year; 3 hrs. laboratory per week, first term.

A laboratory course in special mining problems.

167. Mining. C. G. Williams.

Departments 2, 8, and 9, II Year; 1 hr. lecture per week, first term.

An introductory course of lectures.

168. Mining. C. G. Williams.

Department 8, II Year; 1 hr. lecture per week, second term.

An extension of course 167.

169. Mining Laboratory. F. C. Dyer.

Departments 2 and 9, II Year; 3 hrs. laboratory per week, first term.

A continuation of course 165. Rock drills, sampling methods, use of explosives.

170. Mining. C. G. Williams, F. C. Dyer.

Departments 2 and 9, III Year; 1 hr. lecture per week, both terms.

Principles of mining.

171. Mining. C. G. Williams.

Departments 2 and 9, IV Year; 1 hr. lecture per week, both terms.

Special problems, estimates, reports.

172. Mine Cost Finding and Management. C. G. Williams.

Department 2, IV Year; 1 hr. lecture per week, both terms.

One of the fundamental features that must not be lost sight of by the mining engineer is, that his work is designed primarily for purposes of financial profit. This course of lectures deals with details from this point of view. The total cost of a ton of ore, requiring as it does an understanding of the problems of amortization, is first dealt with in a broad way. Then are considered various problems of cost finding, leading on to problems of time and motion study, which are essential to the development of the fine points of the art in any particular mining problem. The latter part of the course deals with problems of management, the relation of members of the staff to each other, and the relations of the staff to labour.

173. Mine Ventilation and Allied Problems. G. R. Lord.

Department 2, IV Year; 2 hrs. lectures per week, first term.

This course of lectures deals with ventilation problems in Canadian mines, including the use of ventilation equipment, selection of fans, testing equipment, ventilation studies, the silicosis problem, fire control, etc.

174. Mine Ventilation Laboratory. The Staffs in Mining and Mechanical Engineering.

Department 2, IV Year; 3 hrs. laboratory per week, first term.

This course consists of experiments in the laboratories and problems in the study room to give the student some practice in the use of ventilation test equipment, and the solution of ventilation problems.

175. Ore Dressing. C. G. Williams, F. C. Dyer.

Departments 2 and 8, III Year; 1 hr. lecture per week, both terms.

The general principles of ore dressing.

176. Ore Dressing Laboratory. F. C. Dyer.

Departments 2 and 8, III Year; 6 continuous hrs. laboratory per week, second term.

Work with crushing machinery, principles of crushing and grading, screen analyses, concentration with gravity separation apparatus, etc.

177. Ore Dressing. C. G. Williams, F. C. Dyer.

Departments 2 and 8, IV Year; 1 hr. lecture per week, both terms.

Course 175 continued, study of flow sheets, and special problems.

178. Ore Dressing. F. C. Dyer.

Departments 2 and 8, IV Year; 6 continuous hrs. laboratory per week, first term.

Advanced work with ore dressing appliances, ore testing, and check mill runs.

179. Ore Dressing. F. C. Dyer.

Department 6m, IV Year; 1 hr. lecture per week, both terms.

General principles of ore dressing.

180. Ore Dressing Laboratory. F. C. Dyer.

Department 6m, IV Year; 1 period of 6 hrs. laboratory per week, second term.

Department 8a, IV Year; 3 hrs. laboratory per week, both terms.

Principles of sampling, crushing, and grading, screen analyses, concentration with gravity separation apparatus, flotation, ore testing, etc.

181. Physics of Ore Dressing. F. C. Dyer.

Departments 2, 8, and 9, III Year; Departments 6m and 8a, IV Year; 1 hr. lecture per week, both terms.

Ore dressing methods involve a study of the laws governing the phenomena of surface tension, capillarity, and colloidal solutions,

in addition to those of hydrostatics and certain phases of hydraulics. This is embodied in a special course of lectures in conjunction with laboratory work in the ore dressing laboratory.

182. Theory of Measurements. C. G. Williams, F. C. Dyer.

Departments 2 and 9, II Year; 1 hr. lecture per week, first term.

This title is not an entirely suitable one for this course of lectures because it is generally applied to a study of the philosophy of extremely accurate measurements. The mining engineer has to continually make satisfactory use of measurements with a wide range of inaccuracy. This course of lectures deals with the philosophy underlying the causes of these errors and the practical application of such approximations. The opportunity is taken in these lectures to deal with the subject of illustrating measurements by graphs.

183. Introductory Research. C. G. Williams, F. C. Dyer.

Department 2, III Year; 3 hrs. laboratory per week, first term.

This is a laboratory course including some lectures, and is a preparation for the thesis of the Fourth Year.

ASTRONOMY AND GEODESY

200. Practical Astronomy. S. R. Crerar.

Department 1, II Year; 1 hr. lecture per week, second term.

This lecture course deals with the practical determination of time, latitude, and azimuth, by methods adapted to the use of the surveyor's transit. The course will be designed to enable the student to carry out these observations at the Summer Survey Camp.

Reference book: Nautical Almanac, 1940.

201. Astronomy and Geodesy. S. R. Crerar.

Departments 1a and 1b, III Year; 2 hrs. lectures per week, both terms.

The course of lectures deals with the determination of time, latitude, longitude, and azimuth, by methods adapted to the use of the surveyor's transit and the sextant. It is designed to fulfil the requirements of the final examinations for Ontario and Dominion Land Surveyors.

In Geodesy an account is given of the principles and methods of a secondary triangulation survey, also of the principles involved in the North-west system of survey.

Text books: Practical Astronomy as applied to Geodesy and Navigation—Doolittle. Notes on Practical Astronomy and Geodesy. Nautical Almanac.

202. Field Work. S. R. Crerar.

Departments 1a and 1b, III Year; about 2 hrs. per week, first term.

The practical work in this subject comprises observations in the field, with the transit and sextant, for the determination of time, latitude, and azimuth by the methods described in the lectures and the solution of related problems.

203. Astronomy, Advanced. J. W. Melson.

Department 1b, IV Year; 2 hrs. lectures per week, both terms.

The lecture course in this subject comprises the theory and adjustment of the instruments used in connection with a geodetic survey; the methods of taking and reducing observations for time, longitude, latitude, and azimuth, with the precision required on such a survey, and other matters relating to these subjects.

204. Geodesy and Metrology. W. M. Treadgold.

Department 1b, IV Year; 2 hrs. lectures per week, both terms.

The lecture course includes a description of the methods of measuring base lines and the angles of a triangulation; the geometry of the spheroid with applications to geodetic problems; the computation of geodetic positions; the solution of large triangles on the earth's surface, and the adjustment of a triangulation; trigonometric and precise spirit levelling; the determination of the figure of the earth by arc measurements, and by the pendulum; the theory of map projections, etc.

205. Astronomy, Geodesy, and Metrology. W. M. Treadgold, J. W. Melson.

Department 1b, IV Year; about 23 hrs. laboratory per week, both terms.

The practical work in the above subjects includes the observation of meridian transits for time and longitude determinations, and of prime vertical transits for latitude, with the astronomical transit instrument; the observation of meridian zenith distances of stars, and of azimuths at elongation for latitude, with the alt-azimuth; theodolite observations for azimuth; observations for latitude with the zenith telescope; the investigation of the constants of the instruments used, and the reduction of all observations; the measurement of a base line with the steel tape and with invar wires, and the determination of the constants of the tape; the measurements of the angles of a triangulation and the adjustment of the angles of network of triangles, etc. A portion of this work will be taken at the University Survey Camp. (See course 718.)

BIOLOGY

210. Elementary Biology. A. J. V. Lehmann.

Department 6, I Year; 3 hrs. per week, second term.

A lecture and laboratory course dealing with certain phases of the biology of plants and of their microscopic structure.

CHEMISTRY AND CHEMICAL ENGINEERING

220. General Chemistry. E. G. R. Ardagh.

Departments 1, 2, 3, 7, and 9, I Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

An advanced course in inorganic chemistry, with industrial applications.

221. General Chemistry. E. A. Smith.

Departments 5, 6, 8, and 8a, I Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

An advanced course in chemical theory, with industrial applications.

222. Inorganic Chemistry Laboratory. L. J. Rogers.

Department 5, I Year; 3 hrs. laboratory per week, both terms.

Department 6, I Year; 12 hrs. laboratory per week, both terms.

Department 8a, I Year; 9 hrs. laboratory per week, first term; 15 hrs. laboratory per week, second term.

A laboratory course of quantitative experiments illustrating the use of the sensitive balance, and confirming the fundamental laws of chemistry; qualitative inorganic analysis; quantitative analysis of pure salts.

Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

223. Inorganic Chemistry A. R. R. McLaughlin.

Departments 1, 2, 3, 6, 7, 8, 8a, and 9, II Year; 1 hr. lecture per week, first term.

A continuation of courses 220 and 221, dealing principally with the metals.

224. Inorganic Chemistry B. E. G. R. Ardagh.

Departments 2, 6, 8, 8a, and 9, II Year; 1 hr. lecture per week, second term.

A continuation of courses 220 and 221.

Text book: General Chemistry—Deming.

225. Analytical Chemistry. L. J. Rogers.

Departments 2, 6, 8, 8a, and 9, III Year; 1 hr. lecture per week, both terms.

A lecture course on the principles of chemical analysis; select gravimetric and volumetric methods; technical analysis.

226. Analytical Chemistry Laboratory. E. A. Smith, R. R. McLaughlin.

Departments 1 and 3, II Year; 6 hrs. laboratory per week, second term.

Departments 2 and 9, II Year; 6 hrs. laboratory per week to Dec. 1st.

Department 7, II Year; 6 hrs. laboratory per week, first term.

Laboratory course in qualitative and quantitative analysis, accompanied by lectures.

227. Analytical Chemistry Laboratory. E. A. Smith.

Departments 2 and 9, II Year; 6 hrs. laboratory per week, from Dec. 1st.

A laboratory course in the gravimetric determination of metals and acids, with elementary volumetric analysis, accompanied by lectures.

228. Analytical Chemistry Laboratory. L. J. Rogers.

Department 8, II Year; about 14 hrs. laboratory per week, first term; about 13 hrs. laboratory per week, second term.

A laboratory course comprising gravimetric and volumetric methods, acidimetry and alkalimetry.

Text books: Analytical Chemistry, Vol. II—Treadwell-Hall. Qualitative Chemical Analysis—A. A. Noyes.

229. Analytical Chemistry Laboratory. L. J. Rogers.

Department 6, II Year; about 100 hrs. laboratory to Dec. 1st.

Department 8a, II Year; 10 hrs. laboratory per week, first term; 8 hrs. laboratory per week, second term.

A laboratory course in quantitative chemical analysis; inorganic preparations.

Text book: Analytical Chemistry, Vol. II—Treadwell-Hall.

230. Engineering Chemistry. E. A. Smith.

Departments 1, 3, 5, 6, 7, and 8a, II Year; 1 hr. lecture per week, first term.

A lecture course consisting of a study of the industrial production and application of heat, and of the chemistry of fuel and the products of combustion.

231. Industrial Chemistry. J. W. Bain.

Departments 6 and 8a, II Year; 1 hr. lecture per week, both terms.

A lecture course on the manufacture of salts, acids, alkalies, and inorganic chemicals.

232. Industrial Chemistry and Technical Analysis. E. G. R. Ardagh.

Departments 6 and 8a, II Year; about 70 hrs. laboratory, second term.

An introductory laboratory course in industrial chemistry containing experiments on petroleum products, fertilizers, etc., preparation of inorganic salts on a pound scale.

233. Organic Chemistry. M. C. Boswell.

Departments 1, 3, and 5, II Year; 1 hr. lecture per week, second term.

A lecture course upon some of the elementary principles of organic chemistry and their application to selected industries.

234. Industrial and Laboratory Synthesis in Organic Chemistry. M. C. Boswell.

Department 6, II Year; 2 hrs. lectures per week, both terms.

A discussion of the chemical reactions used in synthesis in the laboratory and the factory, and of the conditions under which compounds are brought into reaction, the conditions used for securing high yields, and the methods employed for isolating compounds from reaction mixtures both in the laboratory and in industry.

235. Industrial and Laboratory Methods of Synthesis. M. C. Boswell, R. R. McLaughlin.

Department 6, II Year; about 115 hrs. laboratory, from Dec. 1st.

A laboratory course accompanying lecture course 234.

236. Physical Chemistry. F. B. Kenrick.

Departments 6 and 8a, II Year; Department 9, III Year; 2 hrs. lectures per week, both terms.

A course of lectures on the elements of chemical mechanics, and the theory of solutions.

237. Analytical Chemistry Laboratory. L. J. Rogers.

Departments 2 and 9, III Year; 6 hrs. laboratory per week, first term; 3 hrs. per week, second term.

A laboratory course on the technical analysis of ores and furnace products.

238. Industrial Chemistry and Technical Analysis. E. G. R. Ardagh.

Departments 6 and 8a, III Year; 155 hrs. laboratory.

A continuation of laboratory course 232, containing experimental work on coal, petroleum, illuminating gas, silicates, sugars, starch, etc., potentiometric determination of hydrogen-ion, preparation of inorganic salts on a pound scale. Instruction in glass blowing is given in this course.

Text Books: American Society for Testing Materials. Engineering Chemistry—Stillman. Liquid and Gaseous Fuels—Lewes and Kershaw. Fuels and their Combustion—Haslam and Russell. Determination of Hydrogen Ions—Clark. Technical Methods of Chemical Analysis—Lunge. Handbook for Cane Sugar Manufacturers—Spencer.

239. Analytical Chemistry and Phase Rule. L. J. Rogers, J. T. Burt-Gerrans.
Department 8, III Year; about 6 hrs. laboratory per week, second term.
A laboratory course in analysis and phase rule.

240. Engineering Chemistry. J. W. Bain, E. G. R. Ardagh, E. A. Smith.
Departments 1a, 1b, 2, 3, 6, 7, 8, and 8a, III Year; 1 hr. lecture per week, both terms.
A lecture course on the application of chemistry to engineering problems: air, water, corrosion of metals, explosives, petroleum products, rubber, synthetic resins, etc.

241. Industrial Chemistry. E. G. R. Ardagh.
Department 6, III Year; 1 hr. lecture per week, both terms.
A lecture course on petroleum and its products, coal tar and its products, fats, oils, soap, sugar, starch, rubber, fermentation industries, etc.

242. Chemical Engineering. J. W. Bain.
Departments 6 and 8a, III Year; 1 hr. lecture per week, both terms.
A lecture course on the theory and practice of heat transfer, evaporation, filtration, and other industrial operations.
Text book: Elements of Chemical Engineering—Badger and McCabe.

243. Chemical Engineering. Staff in Chemical Engineering.
Department 6, III Year.
A laboratory course in Chemical Engineering introductory to course 251.

244. Organic Chemistry, Industrial and Laboratory Synthesis. M. C. Boswell.
Department 6, III Year; 2 hrs. lectures per week, both terms.
A continuation of course 234.

245. Industrial and Laboratory Methods of Synthesis in Organic Chemistry. M. C. Boswell, E. A. Smith, R. R. McLaughlin.
Department 6, III Year; 125 hrs.
Laboratory and industrial reactions are performed, in some cases using the following small scale industrial apparatus: filter press, sulphonator, tanks for precipitation, electric stirrer, vacuum evaporator, vacuum drier, fusion pot, ball mill, high pressure autoclaves, pumps for transferring liquids, and materials for constructing electric tube furnaces and thermocouples.

Text books: Manual of Industrial Chemistry (Organic)—Rogers. Practical Methods of Organic Chemistry—Gattermann. Unit Processes in Organic Synthesis—Groggins. Die Methoden der Organischen Chemie—Houben-Weyl.

246. Electrochemistry. J. T. Burt-Gerrans.

Departments 6 and 8, III Year; 2 hrs. lectures per week, first term.

A lecture course on elementary electrochemistry, illustrated by experiments.

247. Electrochemistry Laboratory. J. T. Burt-Gerrans.

Departments 6 and 8, III Year; 3 hrs. laboratory per week, first term.

A laboratory course in quantitative measurements to accompany course 246.

248. Inorganic Chemistry. J. W. Bain.

Department 6, IV Year; 2 hrs. lectures per week, both terms.

A lecture course on chemical theory.

249. Catalysis in Organic Chemical Industry. M. C. Boswell.

Department 6, IV Year; 1 hr. lecture per week, both terms.

This lecture course is a continuation of courses 234 and 244, and embraces as well a discussion of the methods used in several of the industries employing catalysts.

250. Organic Chemistry. R. R. McLaughlin.

Department 8a, II Year; 1 hr. lecture per week, both terms.

Departments 5s and 5g, IV Year; 1 hr. lectures per week, both terms (Session 1939-40 only).

A lecture course on the general reactions and methods of synthesis of carbon compounds.

Text book: Organic Chemistry—Perkin and Kipping.

251. Chemical Engineering and Industrial Organic Chemistry. Staff in Chemical Engineering.

Department, 6, IV Year.

A laboratory course involving quantitative measurements employing the following standard apparatus: still, heat interchanger, absorption column, and filter press. The experiments have been selected to furnish experimental data for the confirmation of some of the principles and mathematical expressions discussed in course 242. The course also includes experiments in industrial chemistry supplementary to course 245.

Text books: Elements of Chemical Engineering—Badger and McCabe. Distillation Principles and Processes—Sydney Young.

252. Chemical Engineering Problems. J. W. Bain, W. C. Macdonald.
Department 6i, IV Year; 2 hrs. lectures per week, second term.
A course dealing with calculations in connection with various problems in chemical engineering.

253. Industrial Chemistry and Chemical Engineering. J. W. Bain.
Department 6i, IV Year; 1 hr. lecture per week, both terms.
A lecture course on selected subjects in chemical technology and chemical engineering.

254. Research. The senior staff in Chemical Engineering.
Department 6, IV Year.
In this course, which occupies about three-quarters of the total time of the year, a research problem is given to each student. This provides experience in searching the primary sources of scientific information and in devising analytical methods and designing apparatus applicable to the new problems. Each student is obliged to write a thesis embodying the results of his search of the original literature and his own experimental work. Thus this course serves as a preparation for the field of research work; and those students who, by ability, taste, and temperament, are fitted for research pass naturally either into industrial research or into the graduate school of the University to pursue further work in this field.

255. Electrochemistry. J. T. Burt-Gerrans.
Departments 6e and 8, IV Year; 2 hrs. lectures per week, both terms.
An advanced lecture course on the theory of solutions and electrolysis, and the application to the practice of electro-deposition and electrolytic refining of metals. The course also includes lectures on the electric furnace with special consideration of efficiency.
Reference books: Electrometallurgy—Borchers. Principles of Applied Electrochemistry—Allmand and Ellingham. The Electric Furnace—Stansfield. The Electric Furnace—Pring. Physical Chemistry for Colleges—Millard.

256. Electrochemistry Laboratory. J. T. Burt-Gerrans.
Departments 6e and 8, IV Year; 6 hrs. laboratory per week, second term.
A laboratory course accompanying course 255.
Reference book: Practical Physical Chemistry—Findlay.

257. Silicate Chemistry. J. B. Ferguson.
Departments 8a and 9, IV Year; 2 hrs. lectures per week, first term.
The application of phase rule to the chemistry of refractory materials.

DESCRIPTIVE GEOMETRY, ENGINEERING PROBLEMS AND DRAWING

DESCRIPTIVE GEOMETRY

270. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3, 5, 6, 7, 8, 8a, and 9, I Year; 1 hr. lecture per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solutions of problems relating to straight lines and planes.

271. Descriptive Geometry. J. R. Cockburn.

Department 4, I Year; 1 hr. lecture per week, both terms.

This course of lectures deals chiefly with the principles of orthographic and oblique projections and the application of such principles to the solution of problems relating to straight lines and planes, special reference being made to the determination of shades and shadows.

272. Descriptive Geometry. J. R. Cockburn.

Departments 1, 2, 3, 5, 7, and 9, II Year; 1 hr. lecture per week, both terms.

This course of lectures is a continuation of the work taken in the First Year, with the following additions: problems relating to curved surfaces, principles of shades, shadows and perspective.

273. Descriptive Geometry. J. R. Cockburn.

Department 4, II Year; 1 hr. lecture per week, both terms.

This course of lectures is a continuation of the work taken in the First Year, with the addition of problems relating to curved surfaces, shades, shadows and perspective.

274. Descriptive Geometry. J. R. Cockburn.

Department 1, III Year; 1 hr. lecture per week, first term.

This course of lectures deals with spherical projections, the principles of mapmaking, and the graphical solution of spherical triangles.

ENGINEERING PROBLEMS AND DRAWING

These courses consist primarily in the solving of problems by the student at the drafting table under the personal guidance of an instructor. The problems are intended to supplement certain lecture courses. The problems in the First and Second Years deal with the fundamental engineering studies—Mathematics, Applied Mechanics, Descriptive Geometry, the plotting of surveys that

have been made by the students in the field, Theory of Mechanism, and Steam Engines, while in the Third and Fourth Years, the problems deal mainly with design. During the hours devoted to mathematical problems, members of the staff in mathematics are present to assist.

275. Engineering Problems and Drawing. A. Wardell.

Department 1, I Year; 10 hrs. per week, first term; 17 hrs. per week, second term.

Drawing and lettering. Plotting of original surveys. Problems in descriptive geometry. Graphical and analytical solutions of problems in applied mechanics. Problems in mathematics (analytical geometry and calculus).

276. Engineering Problems and Drawing. A. Wardell.

Departments 2 and 9, I Year; 9 hrs. per week, first term; 12 hrs. per week, second term.

A course similar to course 275.

277. Engineering Problems and Drawing. A. Wardell.

Department 3, I Year; 9 hrs. per week, first term; 15 hrs. per week, second term.

A course similar to course 275.

278. Engineering Problems and Drawing. A. Wardell.

Department 4, I Year; 3 hrs. per week, both terms.

An elementary course in drawing and lettering. The solving of a few problems in descriptive geometry, applied mechanics, and mathematics.

279. Engineering Problems and Drawing. A. Wardell.

Department 5, I Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

Drawing and lettering. Problems in descriptive geometry. Graphical and analytical solutions of problems in applied mechanics. Problems in mathematics (analytical geometry and calculus).

280. Engineering Problems and Drawing. A. Wardell.

Department 6, I Year; 3 hrs. per week, both terms.

An elementary course in drawing and lettering. The solving of a few problems in descriptive geometry, applied mechanics, and mathematics.

281. Engineering Problems and Drawing. A. Wardell.

Department 7, I Year; 9 hrs. per week, first term; 12 hrs. per week, second term.

A course similar to course 275.

282. Engineering Problems and Drawing. A. Wardell.

Department 8, I Year; 13 hrs. per week, first term; 19 hrs. per week, second term.

A course similar to course 275.

283. Engineering Problems and Drawing. A. Wardell.

Department 8a, I Year; 3 hrs. per week, both terms.

A course similar to course 280.

284. Engineering Problems and Drawing. J. J. Spence.

Department 1, II Year; 5 hrs. per week, first term; 10 hrs. per week, second term.

Problems in descriptive geometry—intersection of curved surfaces. Plotting of original surveys. Problems in mechanics of materials—properties of sections, designs of simple members. Problems in mathematics (calculus).

285. Engineering Problems and Drawing. J. J. Spence.

Departments 2 and 9, II Year; 3 hrs. per week, first term; 10 hrs. per week, second term.

Problems in descriptive geometry, mechanics of materials. Flow sheets.

286. Engineering Problems and Drawing. J. J. Spence.

Department 3, II Year; 15 hrs. per week, first term; 8 hrs. per week, second term.

Problems in descriptive geometry—intersection of curved surfaces. Problems in mechanics of materials, theory of mechanism, steam engines, electricity. Problems in mathematics (calculus).

287. Engineering Problems and Drawing. J. J. Spence.

Department 6, II Year; 7 hrs. per week, first term; 3 hrs. per week, second term.

Problems in mechanics of materials, electricity, and mathematics.

288. Engineering Problems and Drawing. J. J. Spence.

Department 7, II Year; 6 hrs. per week, first term; 9 hrs. per week, second term.

A course similar to course 286, but with more problems in mathematics.

289. Engineering Problems and Drawing. J. J. Spence.

Department 8, II Year; 3 hrs. per week, first term; 6 hrs. per week, second term.

Problems in mechanics of materials, electricity, and descriptive geometry.

290. Engineering Problems and Drawing. J. J. Spence.
Department 8a, II Year; 7 hrs. per week, first term; 3 hrs. per week, second term.
A course similar to course 287.

291. Engineering Problems and Drawing. W. B. Dunbar.
Departments 1a and 1b, III Year; 13 hrs. per week, first term; 14 hrs. per week, second term.
Department 1c, III Year; 14 hrs. per week, first term; 18 hrs. per week, second term.
Department 1d, III Year; 7 hrs. per week, both terms.
Problems in design of steel structures, riveted and welded connections, tension members, beams, columns, highway and railway trusses. Problems in descriptive geometry to illustrate the theory of map making.

292. Engineering Problems and Drawing. W. B. Dunbar.
Department 2, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.
Problems in design of steel structures, riveted and welded connections, tension members, beams, columns.

293. Engineering Problems and Drawing. W. B. Dunbar.
Department 3, III Year; 6 hrs. per week, first term; 3 hrs. per week, second term.
A course similar to course 292.

294. Engineering Problems and Drawing. W. B. Dunbar.
Department 5h, III Year; 3 hrs. per week, both terms.
A course similar to course 292, but less extensive.

295. Engineering Problems and Drawing. W. B. Dunbar.
Department 6, III Year; 3 hrs. per week, both terms.
A course similar to course 292, but less extensive.

296. Engineering Problems and Drawing. W. B. Dunbar.
Department 8, III Year; 3 hrs. per week, first term.

297. Engineering Problems and Drawing. W. B. Dunbar.
Department 8a, III Year; 3 hrs. per week, both terms.
A course similar to course 295.

298. Engineering Problems and Drawing. W. J. Smither.
Department $1a_1$, IV Year; 15 hrs. per week average, both terms.
Department 1c, IV Year; 11 hrs. per week, first term; 10 hrs. per week, second term.

Department 1d, IV Year; 3 hrs. per week, first term; 7 hrs. per week, second term.

A course dealing with advanced problems on the design of steel and reinforced concrete structures—floor panels, mill buildings, tanks, reservoirs, towers, truss and arch bridges, foundations, dams, retaining walls, wind bracing. Problems on moment distribution in rigid frames, influence lines, and deflection of trusses.

299. Engineering Problems and Drawing. W. J. Smither.

Department 3, IV Year; 3 hrs. per week, first term.

A course dealing with problems on the determination of stresses in, and the design of mill, buildings, flume trestles, crane runways, and floor panels for machinery loading.

300. Plant Design. W. J. Smither, R. J. Montgomery.

Department 8a, IV Year; 3 hrs. per week, first term.

A course devoted to the original design of ceramic plants, driers, kilns, etc.

301. Engineering Problems and Drawing. W. J. Smither.

Department $1a_1$, IV Year; 3 hrs. per week, second term.

Problems on the design of water distribution and sewer systems as well as water and sewage treatment works.

ECONOMICS AND BUSINESS ADMINISTRATION

310. Business. R. R. Grant.

Departments 1, 2, 3, 6, 7, 8, 8a, and 9, I Year; 1 hr. lecture per week, second term.

A lecture course on the rudiments of business organizations and the relationship which they bear to accountancy. The preparation of simple financial reports and interpretation of the information which they are intended to furnish.

311. Economics and Finance. C. H. Mitchell.

Departments 1, 2, 3, 4, 6, 7, 8, 8a, and 9, II Year; 1 hr. lecture per week, both terms.

An introduction to the study of Economics. The course deals in an elementary manner with the following:

(1) Scope of economics.
(2) Economic geography.
(3) Theory of value, supply, and demand.
(4) Theory of production and distribution.
(5) Structure of industry and social conditions.
(6) Money, banking, and finance.
(7) Economics of Canada with special reference to the relation of engineering to finance.

Text books: Economics for the General Reader—Clay. Supply and Demand—H. D. Henderson. Annual Financial Reviews.

312. Commercial Law. F. C. Auld.

Departments 4 and 7, III Year; 1 hr. lecture per week, both terms.

General Principles of the Law of Contracts, Principal and Agent, Partnership and Limited Companies, with special reference to the Companies Acts. General view of the following:—Negotiable Instruments, Sale of Goods, Bills of Sale and Chattel Mortgages, Suretyship and Guarantee.

Text book: Manual of Canadian Business Law—Falconbridge and Smith.

313. Engineering Economics. C. R. Young.

Departments 1, 2, 3, 7, 8, and 9, IV Year; 1 hr. lecture per week, second term.

A series of lectures on the principles by which the economic practicability of a project is judged and the comparison of competing proposals is made. Consideration is given to first cost and annual cost, methods of estimating, fixed charges and operating expenses, financing of engineering projects, valuation and appraisals. Special attention is given to depreciation and the methods of providing for it. Typical numerical problems are discussed and solved.

Text books: Engineering Economics—Fish. Financial Engineering—Goldman. Principles of Engineering Economy—Grant.

314. Engineering Law. R. E. Laidlaw.

Departments 1a and 1b, IV Year; 2 hrs. lectures per week, first term.

Departments 3, 6, and 7, IV Year; 1 hr. lecture per week, first term.

This course of lectures is designed to co-ordinate engineering practice and law. In the first term attention is directed to the duties and liabilities of the engineer, workmen's compensation, patents and inventions, copyrights, trade marks, industrial designs, promotion of companies, organization of companies, arbitration, expert evidence, engineering contracts, trade unions, combines, and industrial disputes. The work of the second term comprises drainage, boundaries and surveys, easements, railways, highways, building trades, factories, office buildings, and public buildings.

Text book: Engineering Law—Laidlaw and Young.

315. Contracts and Specifications. C. R. Young.

Departments 1a, 1b, 1c, 4, and 8, IV Year; 1 hr. lecture per week, second term.

This course of lectures deals with the fundamental principles of contract and specification writing. The critical examination of typical specifications and agreements by the class, forms an essential feature of the instruction.

Text books: Elements of Specification Writing—Kirby. Engineering Law—Laidlaw and Young.

316. Management. R. F. Legget.

Departments 1a and 1b, IV Year; 1 hr. lecture per week, first term.

A series of lectures dealing with the fundamental principles upon which management is based. The possibilities of effective management are indicated and its basis is shown to exist in suitable organization, adequate equipment, and smooth administration.

Reference books: Construction Cost Keeping and Management—Gillette and Dana. Principles of Industrial Organization—Kimball. Principles of Industrial Management—Allcut.

317. Plant Management. G. A. Guess.

Department 8, IV Year; 1 hr. lecture per week, second term.

A course of twelve lectures dealing with some phases of labour, plant organization, smelter contracts, and markets.

318. Industrial Management. E. A. Allcut.

Departments 3, 6, 7, and 8a, IV Year; 1 hr. lecture per week, both terms.

This course includes a study of industrial organization, location, arrangement, construction, and equipment of industrial plants for efficiency and economy, process routing, scheduling work, reports, methods of superintending, employment, systems of compensating labour, and systems of distributing indirect expenses.

Text book: Principles of Industrial Management—Allcut.

319. Municipal Administration. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. lecture per week, second term.

A lecture course dealing with municipal government, assessment and taxation, municipal finance, public utilities, expropriation, annexation problems, town planning, local improvement and other laws relating to municipalities.

320. Public Speaking. F. H. Kirkpatrick.

Department 1, II Year; 1 hr. lecture per week, second term.

Department 4, III Year; 1 hr. lecture per week, first term.

A course on the principles of public speaking and the means of expression, accompanied by practical application and training in actual speaking.

ELECTRICITY

330. Electricity. H. W. Price.

Departments 1, 2, 3, 5, 6, 7, 8, 8a, and 9, I Year; 2 hrs. lectures per week, both terms.

A course of lectures on principles relating to electric circuits, magnetic circuits, instruments, and apparatus in general, with illustrations from commercial practice. The point of view is quantitative rather than descriptive.

Reference book: Electrical Engineering, Vol. I—Dawes.

331. Electricity. L. S. Lauchland.

Departments 1, 2, and 9, II Year; 1 hr. lecture per week, both terms.

A course of lectures dealing with fundamental calculations of alternating current circuits and various applications of interest to those who are not making electricity a major subject.

332. Electrical Measurements. J. E. Reid.

Departments 3, 5, 6, 7, 8, and 8a, II Year; 2 hrs. lectures per week, both terms.

A course of lectures on the general principles and calculation of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power, and energy. The principles underlying commercial instruments are considered, together with the methods of calibration.

Reference books: Electrical Measurements—Laws. Electrical Measurements in Theory and Application—Smith. Electrical Measurements and Measuring Instruments—Golding.

333. Electrical Fundamentals. J. E. Reid.

Department 7, II Year; 1 hr. lecture per week, both terms.

A course of lectures extending the study of the fundamental principles underlying the work of course 332. Applications considered are of particular interest to electrical engineers.

334. Electrical Measurements Laboratory. J. E. Reid.

Departments 3, 6, 7, 8, and 8a, II Year; 3 hrs. laboratory per week, both terms.

The more important methods of measurement of resistance, current, potential difference, inductance, and capacity are used, often under conditions such as occur in practice. The principles of measurement are applied to other problems such as the location of line faults and the measurement of temperature rise by resistance changes. Methods of calibrating commercial instruments are also included.

335. Electrical Measurements Laboratory. J. E. Reid.

Department 5, II Year; 3 hrs. laboratory per week, first term.

A modified course based on course 334.

336. Mathematical Applications in Electrical Engineering. V. G. Smith.

Department 7, III Year; 1 hr. lecture per week, both terms.

These lectures are intended to co-ordinate certain branches of mathematics, such as complex numbers, simple determinants, and elementary differential equations, with their applications to the problems of electrical engineering.

337. Thermionic Tubes. B. deF. Bayly.

Department 7, III Year; 1 hr. lecture per week, both terms.

This course of lectures covers the fundamental principles of thermionic devices with their application as rectifiers, control devices and amplifiers. Both gaseous and high vacuum devices are included. The laboratory work is covered in course 344.

Reference books: Communication Engineering—Everitt. Fundamentals of Vacuum Tubes—Eastman. Fundamentals of Engineering Electronics—Dow.

338. Direct Current Machines. A. R. Zimmer.

Department 3, III Year; 1 hr. lecture per week, both terms.

A course of lectures on the theory and operation of direct current generators and motors dealing with armature reaction, losses, efficiency, methods of motor control and special types of generators.

Reference books: Electrical Engineering, Vol. I—Dawes. Electrical Circuits and Machinery, Vol. I—Morecroft and Hehre. Elements of Electrical Engineering—Cook.

339. Direct Current Machines. G. F. Tracy.

Departments 5 and 7, III Year; 1 hr. lecture per week, both terms.

A course of lectures on the theory of operation of direct current machines. Methods of calculating the operating characteristics of generators and motors are presented and illustrated by the use of problems.

Reference books: Electrical Engineering, Vol. I—Dawes. Electrical Circuits and Machinery, Vol. I—Morecroft and Hehre. Principles of D.C. Machines—Langsdorf. Direct Current Machinery—Pender. Electrical Engineering—Christie. Elements of Electrical Engineering—Cook. D.C. Machinery—Kloeffler, Brenneman and Kerchner. Direct Current Machinery—McFarland. Direct Current Machinery—Bull.

340. Alternating Currents. A. R. Zimmer.

Departments 3, 6, 8, and 8a, III Year; 1 hr. lecture per week, both terms.

A lecture course dealing with measurements in simple single-phase and polyphase circuits. Circuit problems are solved by analytical and graphical methods. The operation of induction and synchronous motors and transformers is discussed briefly.

Reference books: Electrical Engineering, Vol. II—Dawes. Electrical Circuits and Machinery, Vol. II—Morecroft and Hehre. Elements of Electrical Engineering—Cook.

341. Alternating Currents. A. R. Zimmer.

Departments 5 and 7, III Year; 1 hr. lecture per week, both terms.

A first course of lectures on alternating current, covering principles of measurement and leading to the analytical and graphical treatment of the simpler problems relative to alternating-current circuits and machinery.

Reference books: Electricity and Magnetism for Engineers, Part II—Pender. Electrical Engineering—Christie. Electrical Engineering, Vol. II—Dawes. Electrical Circuits and Machinery, Vol. II—Morecroft and Hehre. Alternating Current Circuits—Kerchner and Corcoran. Alternating Current Circuits—Bryant, Correll and Johnson. Alternating Current Electrical Engineering—Maccall. Alternating Current Electrical Engineering—Kemp. Elements of Electrical Engineering—Cook.

342. Electrical Design. R. J. Brown.

Departments 5c, 5s, 5i, and 7, III Year; 1 hr. lecture per week, both terms.

This course of lectures deals with the derivation of formulae and the methods used in the design of magnets, direct current machines, transformers, and other electrical equipment.

343. Electrical Problems and Design Laboratory. R. J. Brown, G. F. Tracy, A. R. Zimmer.

Department 7, III Year; 6 hrs. laboratory per week, both terms.

In this course the student designs such electrical apparatus as coils, electro-magnets, direct current machines, reactors and transformers. Some of the time allotted to this course is used for electrical problems in connection with courses 339 and 341.

344. Electrical Laboratory. H. W. Price, G. F. Tracy, A. R. Zimmer, B. deF. Bayly.

Department 7, III Year; 6 hrs. laboratory per week, both terms.

This laboratory course consists of a group of experiments on direct current machines, another group on the fundamentals of alternating current circuits, together with experiments on properties of magnetic materials, and on the fundamentals of thermionic devices. Introductory experience in the use of alternating current machinery is afforded.

345. Electrical Laboratory. H. W. Price, G. F. Tracy, A. R. Zimmer.

Departments 5c, 5g, 5i and 5s, III Year; 6 hrs. laboratory per week, both terms.

Course 344 with the studies on thermionic devices replaced by some introductory experiments on alternating current machines.

346. Electrical Laboratory. H. W. Price, G. F. Tracy, A. R. Zimmer.
Department 3, III Year; 4½ hrs. laboratory per week, first term: 3 hrs. laboratory per week, second term.
A modified course based on course 345.

347. Electrical Laboratory. H. W. Price, G. F. Tracy, A. R. Zimmer .
Department 5h, III Year; 3 hrs. laboratory per week, both terms
A modified course based on course 344.

348. Electrical Laboratory. H. W. Price, G. F. Tracy, A. R. Zimmer.
Department 8, III Year; 3 hrs. laboratory per week, both terms.
A modified course based on course 344.

349. Electrical Laboratory. H. W. Price, G. F. Tracy, A. R. Zimmer.
Departments 6 and 8a, III Year; 3 hrs. laboratory per week, second term.
This short course includes experiments on direct current generators and motors, and alternating current circuits and machines.

350. Electrical Laboratory. H. W. Price, G. F. Tracy, A. R. Zimmer.
Departments 1, 2, and 9, II Year; 3 hrs. laboratory per week, second term.
Department 2, IV Year; 3 hrs. laboratory per week, first term (1939-40, 1940-41).
In this short course the experiments are planned to give a general knowledge of the operation of direct current machines, simple alternating current circuits, and alternating current machines.

351. Alternating Current Circuit Analysis. V. G. Smith.
Departments 5c and 7, IV Year; 2 hrs. lectures per week, both terms.
A lecture course in which applications of advanced analytical methods are made to a.c. bridges, electrical filters, and other networks. Several general network theorems are obtained. The method of symmetrical components is developed and used to solve problems involving unbalance in three-phase circuits. Complex wave forms of voltage and current and their analysis are considered in detail. Simple transients in a.c. circuits are also studied.
Reference books: Principles of Alternating Currents—Lawrence. Alternating Current Circuits—Weinbach. Alternating Current Bridge Methods—Hague. Symmetrical Components—Wagner and Evans. Alternating Current Circuits—Kerchner and Corcoran.

352. Electrical Transmission of Energy. V. G. Smith.
Departments 5c and 7, IV Year; 1 hr. lecture per week, both terms.
A course of lectures dealing with the essential factors involved in the electrical transmission of energy. The distributed inductance

and capacity of a three-phase transmission line are found. The behaviour of a long line when the voltages and currents are sinusoidal is examined in detail. Graphical constructions are developed and applied to both short and long lines.

Reference books: Transmission Line Theory—Franklin and Terman. Principles of Transmission in Telephony—Weinbach.

353. Alternating Current Machinery. G. F. Tracy.

Department 7, IV Year; 2 hrs. lectures per week, both terms.

A course of lectures on the theory of operation of alternating current machines: generators, synchronous motors, parallel operation of generators, single and polyphase induction motors. Methods of calculating the operating characteristics of these machines are presented and illustrated by the use of problems.

Reference books: Theory of Alternating Current Machinery—Langsdorf. Principles of Alternating Current Machinery—Lawrence. Alternating Current Machines—Puchstein and Lloyd. Alternating Current Machinery—Bryant and Johnson. Electrical Engineering—Christie.

354. Alternating Current Measurements. H. W. Price.

Department 7, IV Year; 1 hr. lecture per week, both terms.

Power and instrument transformers; indications of meters on non-sine wave forms due to non-sine voltage or non-linear properties of receiving devices, etc., and related matters; studies of meter indications from connection diagrams and the development of connections for desired indications.

355. Electrical Laboratory. H. W. Price, A. R. Zimmer, R. J. Brown, L. S. Lauchland, J. E. Reid.

Department 7, IV Year; 16 hrs. laboratory per week, both terms.

This laboratory course covers studies of principles and properties of single-phase and polyphase circuits and apparatus. Vector and analytical methods are applied to the solution of problems related to the characteristics of transformers, alternators, synchronous motors, converters, induction motors, transmission lines, and other alternation current equipment.

Reference books: Electrical Engineering—Christie. Experimental Electrical Engineering, Vols. I and II—Karapetoff. Principles of A.C. Machinery—Lawrence. A.C. Machinery—Bryant and Johnson. Principles of Alternating Current Machinery—Langsdorf.

356. Electrical Laboratory. H. W. Price, A. R. Zimmer, R. J. Brown, J. E. Reid, L. S. Lauchland.

Department 5c, IV Year; 6 hrs. laboratory per week, both terms.

A modified course based on course 355.

357. Thermionic Tubes. B. deF. Bayly.

Departments 5c, 5s, 5i, and 7c, IV Year; 2 hrs. lectures per week, first term.

A lecture course on vacuum tubes and their application, including circuits for amplification, modulation, detection, etc.

Reference books: Communication Engineering—Everitt. Fundamentals of Vacuum Tubes—Eastman. Fundamentals of Engineering Electronics—Dow.

358. Thermionic Tube Laboratory. B. deF. Bayly.

Department 7c, IV Year; 9 hrs. laboratory per week, first term.

This course is taken in connection with course 357. The work in the laboratory covers experiments necessary to verify the theories and show methods of measurement used in connection with thermionic tubes.

359. Thermionic Tube Laboratory. B. deF. Bayly.

Departments 5c, 5i, and 5s, IV Year; 6 hrs. laboratory per week, first term.

A modified course based on course 358.

360. Acoustics. B. deF. Bayly.

Departments 5c, 5s, and 7c, IV Year; 1 hr. lecture per week, first term.

A lecture course dealing with the principles of recording, transmission, and reproduction of sound in connection with electrical systems. Mechanical vibrating systems; microphones; loud speakers; causes of distortion; principles of hearing; reverberation.

Reference books: Elements of Engineering Acoustics—Hughes. A Text Book of Sound—Wood. Accoustics—Stewart and Lindsay.

361. Communication Networks. B. deF. Bayly.

Departments 5c, 5s, and 7c, IV Year; 2 hrs. lectures per week, second term.

This course covers the fundamental networks used in electrical communication, such as filters, bridges, impedance matching networks, etc.

Reference books: Communication Engineering—Everitt. Communication Networks, Vols. I and II—Guillemin. Alternating Current Bridge Methods—Hague. High Frequency Measurements—Hund.

362. Communication Laboratory. B. deF. Bayly.

Department 7c, IV Year; 9 hrs. laboratory per week, second term.

This laboratory work concerns principles of measurement and demonstration of principles described in course 361.

363. Communication Laboratory. B. deF. Bayly.

Departments 5c, and 5s, IV Year; 6 hrs. laboratory per week, second term.

A modified course based on course 362.

364. Operational Methods. V. G. Smith.

Departments 5c, 5i, and 5s, IV Year; 2 hrs. lectures per week, both terms.

A few examples of earlier operational methods are given. The operators of electric circuits are developed and solutions obtained, in the course of which several useful rules concerning shifting and transfer operations, and differentiation and integration with respect to parameters are found and applied. The Heaviside expansion theorem is developed in a simple manner. The connection between Heaviside's methods and the classical methods of Fourier Integrals and Contour Integration is investigated in some detail. Application is made throughout to engineering problems, chiefly in the field of electric circuit analysis.

Reference books: Electromagnetic Theory—Heaviside. Operational Circuit Analysis—Bush. Electric Circuit Theory and the Operational Calculus—Carson. Heaviside's Operation Calculus—Berg. Fourier Integrals for Practical Applications—Campbell and Foster.

365. Applied Electromagnetic Theory. V. G. Smith.

Departments 5c, 5g, and 5s, IV Year; 2 hrs. lectures per week, both terms.

The capacity of cables and transmission lines is computed and a comparison made between exact and approximate formulae. The laws of electromagnetism are reviewed with emphasis upon the duality of electromagnetic phenomena. Plane electromagnetic waves and their reflection and refraction at plane surfaces are studied. Skin effects in cylindrical conductors, both solid and hollow, are considered. The laws and formulae of the radiation of energy from vertical antennas are developed. Magnetic fields due to conductors carrying current in the neighbourhood of ferromagnetic bodies are investigated in some of the more simple cases.

Reference books: Electromagnetic Theory—Heaviside. Electricity and Magnetism—Jeans. Electromagnetic Problems in Electrical Engineering—Hague. Classical Electricity and Magnetism—Abraham-Becker.

GEOLOGY

380. Geological Field Work. E. S. Moore.

Departments 2 and 9, III Year; one week at the University Survey Camp preceding the opening of the first term.

381. Geology, Pleistocene and Physiographic. A. MacLean.

Departments 2 and 9, IV Year; 1 hr. lecture per week, both terms.

Pleistocene Geology. Lectures on the formation and distribution of the drift deposits of North America, with brief references to other regions. Glacial, interglacial, and postglacial beds are described, changes of climate, with their probable causes, are discussed and the economic features of the clays, sands, and gravels are considered.

Physiography. A course of lectures on the surface forms of the earth, and on the geological factors that have produced them. The broad features of the earth, its plains, tablelands, hills, valleys, mountains, oceans, rivers, and lakes are discussed in a general way; methods of topographical surveying and mapping are referred to, and the chief physiographic areas of Canada are described.

Reference books: Ice Ages, Recent and Ancient—Coleman. Physiography—Salisbury.

382. Elementary Geology. J. Satterly.

Department 1, II Year; Department 5g, III Year; 2 hrs. lectures per week, second term.

A course in general geology with special reference to Canadian formations.

Text book: Outlines of Geology—Longwell, Knapf, Flint, Schuchert and Dunbar.

383. Historical Geology. V. J. Okulitch.

Department 9, III Year; 2 hrs. lectures per week, both terms.

Principles of sedimentation, divisions of the geological column, and the use of fossils in correlation of formations.

Text book: Historical Geology—Schuchert and Dunbar.

384. Historical Geology Laboratory. V. J. Okulitch.

Department 9, III Year; 3 hrs. laboratory per week, both terms.

Study of fossils, sediments, and geological maps and sections. A laboratory course to accompany course 383.

385. Geology and Ore Deposits. J. Satterly.

Departments 8 and 8a, II Year; 1 hr. lecture per week, both terms.

Lectures on dynamic, structural, historical and economic geology to familiarize the student with the more important principles and terms of geology.

Reference book: As in course 382.

386. Geology and Ore Deposits Laboratory. J. Satterly.

Departments 8 and 8a, II Year; 1 hr. laboratory per week, both terms.

A laboratory course to accompany course 385.

387. Engineering Geology. A. MacLean.

Departments 1a and 1b, III Year; 1 hr. lecture per week, both terms.

This course deals with the application to engineering of dynamic, structural, and economic geology.

Reference book: Engineering Geology—Ries and Watson.

388. General Geology. G. B. Langford.

Departments 2 and 9, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Lectures on geological principles, designed to introduce the student to the study of geology.

Reference books: Geology—Emmons, Thiel, Stauffer, and Allison. Outlines of Geology—Longwell, Knopf, Flint, Schuchert, and Dunbar.

389. General Geology. G. B. Langford.

Departments 2 and 9, II Year; 2 hrs. laboratory per week, second term.

A laboratory course on maps and sections to accompany course 388.

390. Structural Geology. G. B. Langford.

Department 9, III Year; 2 hrs. lectures per week, first term.

A study of the structures caused by the deformation of the earth's crust.

Text books: Geologic Structures—Willis. Structural Geology—Nevin.

391. Structural Geology. G. B. Langford.

Department 9, III Year; 3 hrs. laboratory per week, both terms.

Work with geological maps of folded and faulted areas, structure sections, and the solution of problems relating to folding and faulting. Laboratory course to accompany course 390.

392. Precambrian Geology. E. S. Moore.

Departments 2, 5g, and 9, IV Year; 2 hrs. lectures per week, first term.

Lectures on the Precambrian formations of Canada—their rocks, distribution, relationships, and economic features. Briefer accounts are given of similar formations in the United States and elsewhere.

Reference books: Reports of the Geological Survey of Canada and of the Ontario Department of Mines. Reports of the United States Geological Survey.

393. Mining Geology. G. B. Langford.

Department 9, IV Year; 2 hrs. lectures per week, both terms.

Detailed study of the geology of Canadian and foreign mining camps.

394. Mining Geology. G. B. Langford.

Department 9, IV Year; 3 hrs. laboratory per week, both terms.

A laboratory course to accompany course 393.

395. Field Methods. G. B. Langford.

Department 9, IV Year; 3 hrs. laboratory per week, both terms.

A course covering the principles of geological surveying and map-making, the making of mine models and block diagrams, and the graphic representation of complex geological structures.

396. Mining Geology. E. S. Moore.

Departments 2 and 5g, IV Year; 2 hrs. lectures per week, second term.

A course of lectures on geological problems associated with mining, typical mining regions in Canada, the United States, and elsewhere being discussed from the geological side.

Reference books: Mineral Industry. Geology Applied to Mining —Spurr; and the works mentioned under course 392.

397. Geological Excursions. A. MacLean.

Departments 2 and 9, IV Year.

During October weekly trips will be made to points of interest near Toronto.

398. Economic Geology. E. S. Moore.

Departments 2 and 9, III Year; Department 5g, IV Year.

(*a*) Ore Deposits: 1 hr. lecture per week, both terms.

Discussion of the origin and classification of ore deposits, the mode of occurrence of the chief ores, and statistics of production. Special attention is given to the metals mined in Canada.

(*b*) Economic Geology of the Non-metals: 2 hrs. lectures per week, second term.

Lectures on the origin and mode of occurrence of the valuable non-metallic substances—coal, oil, building stone, gypsum, cement materials, etc.

Reference books: Economic Geology—Ries. General Economic Geology—Emmons. Coal—Moore. Practical Oil Geology—Hager. Mineral Resources of Canada—Moore. Introduction to the Study of Ore Deposits—Hatch.

399. Economic Geology Laboratory. G. B. Langford.
Department 2, III Year; 2 hrs. laboratory per week, first term.
Laboratory work on ores, manner of occurrence, vein structure, etc., also the examination and construction of geological maps and sections of typical mining regions.

400. Economic Geology Laboratory. G. B. Langford.
Department 9, III Year; Department 5g, IV Year; 3 hrs. laboratory per week, both terms.
Laboratory work on ores, geological features of mining areas, interpretation of drill logs, geological maps, and structure sections.

401. Location of Mineral Deposits. E. S. Moore.
Department 5g, IV Year; 2 hrs. lectures per week, second term.
Geological features and principles involved in the application of geophysical methods in the search for mineral deposits, and the interpretation of the structure of the earth's crust.

402. Economic Geology. J. Satterly.
Department 8a, IV Year; 2 hrs. lectures per week, second term.
The nature, occurrence, and origin of non-metallic deposits, excepting fuels.
Reference book: Industrial Minerals and Rocks—A.I.M.E.

403. Geology of Canada. A. MacLean.
Department 9, IV Year; 2 hrs. lectures per week, both terms.
A survey of the physiography, historical geology, major structural features, and mineral deposits of the country.

404. Geology of Canada. A. MacLean.
Department 9, IV Year; 3 hrs. laboratory per week, second term.
A laboratory course to accompany course 403.

405. Building Stones. E. S. Moore.
Department 4, IV Year; 1 hr. per week, first term.
Lectures and laboratory work on decorative and structural stones used in building; their properties, sources, extraction, and preparation for use in buildings.

HEAT ENGINES

420. Elementary Heat Engines. E. A. Allcut, R. C. Wiren.
Departments 3 and 7, II Year; 1 hr. lecture per week, both terms.
Departments 2, 8, and 9, II Year; 1 hr. lecture per week, first term.
Lecture courses on the history and development of heat engines generally, the principles upon which they operate, and brief descriptions of the mechanical and thermal features of the different kinds of heat engines used in practice.

421. Theory of Heat Engines. E. A. Allcut.

Departments 3, 6, 7, and 8a, III Year; 2 hrs. lectures per week, both terms.

A lecture course dealing with the application of the laws of thermodynamics to indicate the best conditions for heat engine operation and the maximum possible efficiency, as exemplified by the Carnot and regenerative cycles. The properties of working fluids are studied, and the effect of departures from the perfect cycle is illustrated by the Joule, Otto, Diesel,and Rankine cycles. The uses of entropy diagrams and refrigeration cycles are also considered briefly.

422. Heat Engines, General. R. C. Wiren.

Departments 3 and 8, III Year; 1 hr. lecture per week, both terms.

A lecture course on heat engine practice as exemplified by steam and internal combustion engines and turbines, air compressors, etc.

Department 3, III Year; 1 hr. lecture per week, first term.

Steam generators and plant. A lecture course on combustion as applied to the design of boiler furnaces and the application of the laws of heat transfer to the problem of steam production generally.

Department 3, III Year; 1 hr. lecture per week, second term.

Air conditioning and ventilation. A lecture course dealing with heating and cooling loads, heat transmission through walls, air conditioning, and similar matters.

423. Heat Engine and Mechanical Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, III Year; 1 three-hr. laboratory period per week, both terms.

Department 7, III Year; 3 hrs. laboratory per week, first term.

Time to be in three-hr. periods in all cases.

This laboratory course is designed to assist in a clearer understanding of thermodynamics, machine design, and mechanics of machinery. The work on heat engines consists in the setting of slide valves, indicating engines, measuring the brake horse-power, simple engine and boiler tests, and the testing of gas and gasoline engines under various conditions. The mechanical laboratory work deals with the efficiency of belts as well as of several machines of simple construction. An examination of lubricating oils is also made by means of well-known methods. Experiments are also made on the balancing of rotating masses.

424. Heat Power Engineering. E. A. Allcut.

Departments 3 and 7t, IV Year; 2 hrs. lectures per week, both terms.

This is a continuation of lecture course 421, the general thermo-

dynamic theory being applied particularly to the transitional stage between gases and vapours and to the formation of vapours from liquids. The heat losses occurring in the various steam and vapour cycles are analysed and the conditions necessary for best thermal efficiency are indicated. The theory of the flow of gases and vapours and its application to turbines, and for purposes of measurement are also discussed.

425. Heat Transmission and Refrigeration. E. A. Allcut.

Departments 3 and 7t, IV Year; 1 hr. lecture per week, first term.

The application of the laws of heat transfer to heat insulation and cooling problems is followed by a consideration of the various methods of producing low temperatures for the storage of materials and for air conditioning. The relative advantages of the different refrigerating fluids are also discussed.

Internal Combustion Engines. E. A. Allcut.

Departments 3 and 7t, IV Year; 1 hr. lecture per week, second term.

The difference between the efficiencies theoretically attainable and those actually achieved in internal combustion engines is examined in detail. The properties of the fuels used in gasoline and Diesel engines, the methods of testing them, and the various heat losses are described. Some consideration is also given to supercharging, detonation, cooling, and similar practical problems.

426. Heat Engine Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Department 3, IV Year; average $7\frac{1}{2}$ hrs. laboratory per week, both terms.

Department 7t, IV Year; 6 hrs. laboratory per week, both terms.

The work in this year is a continuation and extension of the work covered in the Third Year laboratory course. Complete tests are made of heaters and of engines of various types, such as simple, tandem, and cross-compound steam engines, steam turbine, refrigerating machine, injectors, and steam pumps, etc., and an application is made of Hirn's analysis and the entropy diagram to the results obtained. A complete set of experiments is made on each machine and the result plotted to show clearly to the student the effect of various alterations in the adjustment of the engine on the resulting efficiency.

Several modern gas, Diesel, and gasoline engines give ample opportunity for the study of these types of engines, and facilities are provided for sampling the gas supply and exhaust.

Two experimental stacks and three boilers enable results to be obtained on boiler efficiency and chimney draft.

427. Theory of Heat Engines. R. C. Wiren.

Departments 1a, 1b, and 8, III Year; Department 2, IV Year; 1 hr. lecture per week, both terms.

This lecture course describes the principles upon which an ideal heat engine operates, with particular reference to the Carnot and regenerative cycles. Modifications used in practice are illustrated by the internal combustion, air compressor, and Rankine cycles. The use of entropy diagrams in connection with these cycles is also explained and the flow and measurement of gases are described briefly.

428. Heat Engine Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Departments 1a and 1b, III Year; eight 3-hr. laboratory periods, second term.

Department 6, III Year; average 1½ hrs. laboratory per week, second term.

Department 8, III Year; 3 hrs. laboratory per week, second term.

Department 8a, III Year; 1½ hrs. laboratory per week, second term.

Department 2, IV Year; 3 hrs. laboratory per week, first term.

A course of experiments with steam and gas engines, compressed air, etc.

429. Thermodynamics and the Theory of Heat Engines. R. C. Wiren.

Departments 1d and 5h, III Year; 2 hrs. lectures per week, both terms.

The lecture course consists of a study of thermodynamic cycles and their application to engines, compressors, turbines, and refrigerating machines. The properties and limitations of the various working fluids are also considered in relation to their use in such machines.

430. Heat Engine Laboratory. R. W. Angus, E. A. Allcut, R. C. Wiren.

Departments 1d and 5h, III Year; 3 hrs. laboratory per week, second term.

This laboratory work comprises a series of experiments on heat engines and apparatus to show how the principles given in lecture course 429 are applied in practice.

431. Aircraft Engines. E. A. Allcut.

Departments 1d and 5h, IV Year; 1 hr. lecture per week, both terms.

The lectures in the first term include the history and development of aircraft engines, fuel mixtures and carburetors, spray valves and cylinder details. Those in the second term are identical with the lectures on "Internal Combustion Engines", course 425, and are taken in conjunction with IV Year, Departments 3 and 7t.

HYDRAULICS AND HYDROSTATICS

440. Hydraulics. R. W. Angus.

Departments 1a, 1b, 2, 3, 6, and 7, III Year; Department 8a, IV Year; 2 hrs. lectures per week, both terms.

A course of lectures in hydraulics devoted to the development and discussion of formulae relating to the flow of water in pipes, the measurement of discharge by various methods, such as orifices and weirs, the conditions of flow obtaining in open channels, artificial and natural, and in pipes flowing partially full, together with other kindred subjects.

The object of this course is to provide the student with a good working knowledge of the fundamental principles of hydraulics, such as are useful in practical work and are necessary to the intelligent investigation of more advanced problems, and such as the design of water supply, sewerage and irrigation systems, and water power plants.

Text book: Hydraulics for Engineers—Angus.

441. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Departments 1a, 1b, 2, 3, and 7, III Year; Department 8, IV Year; one 3-hr. laboratory period per week, second term.

Department 6, III Year; Department 8a, IV Year; 3 hrs. laboratory per week, first term.

The work in this course is intended to illustrate the lecture course given in hydraulics and to give the student some working acquaintance with the formulae derived. Experiments are made to determine the coefficients for orifices of the various types used in practice and for weirs. The results of these experiments are used in measuring the discharge in subsequent experiments on meters and for the determination of hydraulic resistances in various cases of flow in pipes. The complete course illustrates very fully the application of the course of lectures to actual cases.

442. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 1 hr. lecture per week, both terms.

A course of lectures dealing with the various problems of unsteady flow such as occur in power plants, penstocks, etc. Much of the work is done by the process of arithmetic integration, and the lecture work is supplemented by problems solved by the students in the work rooms, the time for which is included in course 444. Surges, water hammer, stream flow data, etc., are discussed.

The problems of collection of water for power purposes, use of the mass curve, rainfall and evaporation, turbine governing, etc., are also treated as far as possible.

Text book: Hydraulics for Engineers—Angus.

443. Hydraulics. R. W. Angus.

Departments 3 and 7h, IV Year; 2 hrs. lectures per week, both terms.

The most important question considered, and to which most of the lectures are devoted, is the theory of turbines and centrifugal pumps, the effect of the design on the speed, discharge, and efficiency being fully taken up. The course includes the selection of turbines and pumps for given service; intakes, draft tubes, and all matters connected with hydraulic power plants.

Text book: Hydraulics for Engineers—Angus.

444. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Department 7h, IV Year; 6 hrs. laboratory per week, both terms; Department 3, IV Year; average of 7 hrs. laboratory per week in 3 and 2 hr. periods, both terms.

A laboratory course devoted to experimental work on turbines of various types, and centrifugal and turbine pumps and other similar devices. This experimental work is arranged to illustrate the lectures on turbine and pump design. The experiments are made on hydraulic models and on two large turbine pumps used in the laboratory supply, as well as on apparatus specially designed for instruction. Various methods of measuring water-power and the efficiency of machines are also given. A list of the equipment now available and which is used in this course, is given in Section XII.

445. Hydraulics. R. W. Angus.

Department 1a, IV Year; 1 hr. lecture per week, both terms.

This course of lectures deals with general hydraulic problems such as surges in pipe lines, water hammer, flow in open channels and backwater, mass curves and a general discussion of pumps.

Text book: Hydraulics for Engineers—Angus.

446. Hydraulic Laboratory. R. W. Angus, R. Taylor.

Department 1a, IV Year; one 3 hr. laboratory period per week, first term.

This course is primarily intended to supplement course 445, and experiments are carried out on turbines and pumps, current meter, rating, etc. Problems are worked out in the class room and mass curves, etc., are plotted.

Text book: Hydraulics for Engineers—Angus.

447. Hydrostatics. R. W. Angus.

Departments 3, 6, 7 and 8a, II Year; 1 hr. lecture per week, second term.

Fluid pressure and its application in the design of engineering structures. Forces acting on the bottoms and ends of tanks; pressures on pipes, gates and walls; stability of dams; laws governing the equilibrium of floating bodies.

Text book: Hydraulics for Engineers—Angus.

448. Properties of Fluids. G. R. Lord.

Department 3, I Year; 1 hr. lecture per week, both terms.

This course of lectures is intended to prepare the student for work in hydraulics, thermodynamics and machine design.

449. Properties of Fluids. G. R. Lord.

Department 3, II Year; 1 hr. lecture per week, both terms.

This lecture course is a continuation of course 448.

MACHINERY

460. Machines and Processes. W. G. McIntosh.

Department 3, I Year; 1 hr. lecture per week, both terms.

In this lecture course the various machines and processes used in shops are treated in a simple manner, to acquaint the student with the nature of such work. The course is largely descriptive.

Text books: Factory Equipment—Roe and Lytle. Metal Castings—Campbell.

461. Machines and Processes. W. G. McIntosh.

Department 3, II Year; 1 hr. lecture per week, both terms.

This course of lectures is a continuation of course 460 in the First Year, but dealing more particularly with materials of design and production methods. In addition, standards, tolerances, limits, fits, and mechanical drafting room practice will be explained.

Text books: Factory Equipment—Roe and Lytle. Machine Drawing—Tozer and Rising. Drawings and Drafting Room Practice.

462. Elementary Machine Design. W. G. McIntosh.

Departments 6, 7 and 8a, II Year; 1 hr. lecture per week, both terms.

This is a preparatory course intended to familiarize the student with the different shop methods and processes, casting, forging, machining, etc., used in the production of machine parts, to enable him to make proper provision in the design of such parts to facilitate their production.

In addition, the various standards, machine and pipe threads, tapers, pipe fittings, etc., are described and mechanical drafting room practice explained. Tolerances, limits, fits and gauges are discussed.

Text book: Factory Equipment—Roe and Lytle. Drawings and Drafting Room Practice.

463. Machinery. G. R. Lord.

Departments 1a and 1b, III Year; 1 hr. lecture per week, both terms.

This course of lectures is intended to give the civil engineer some acquaintance with the machinery used in bridges, machinery for conveying and moving materials, shovels, pumping, etc.

Text book: Machine Design—Berard and Waters.

464. Machinery Design Laboratory. W. G. McIntosh, G. H. Hally.

Departments 1a and 1b, III Year; 3 hrs. laboratory per week, second term.

The work in the laboratory and the drafting problems assigned will illustrate the lecture course.

465. Theory of Mechanism. R. Taylor.

Departments 3 and 7, II Year; 2 hrs. lectures per week, both terms.

This course of lectures treats of the elementary construction of machines and of the motions of the various parts. Methods of determining linear and angular velocities, methods for the solution of elementary problems involving forces, and methods for the determination of the mechanical efficiency of machines are discussed. Velocity diagrams, crank effort, and torque diagrams are plotted. Cams, toothed gearing, and various types and applications of trains of gearing are considered.

Text book: Theory of Machines—Angus.

466. Mechanics of Machinery. G. R. Lord.

Departments 3 and 7, III Year; 1 hr. lecture per week, both terms.

This course is devoted to a consideration of accelerations in machines, acceleration and inertia forces and effects, balancing of machines, kinetic energy of machines, speed fluctuations, proper weight of fly-wheel.

Applications of the methods described are made to various machines, including engines, machine tools, link motions, etc.

The methods of analysis employed are those developed in course 465.

Text book: Theory of Machines—Angus.

467. Machine Design. W. G. McIntosh.

Departments 3 and 7, III Year; 2 hrs. lectures per week, both terms.

This course of lectures deals with the design of various machine elements, including screw threads for fastening and power transmission, shafting, bearings (journal, thrust, ball, and roller) belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Faires.

468. Machine Design and Mechanics of Machinery Laboratory. W. G. McIntosh, G. H. Hally.

Department 3, III Year; an average of 8 hrs. laboratory per week, both terms.

Department 7, III Year; 3 hrs. laboratory per week, both terms.

The work in the laboratory will consist of analytical and graphical solution of problems illustrating the principles involved in the lecture course in Mechanics of Machinery, and the design of machine parts covered in the lecture course in Machine Design. The object of the work on the drafting board is with a view to developing the students' judgment and sense of proportions in design and the application of drafting room standards.

469. Machine Design. W. G. McIntosh.

Departments 2, 6, 8, and 8a, IV Year; 1 hr. lecture per week, both terms.

The lectures in this course deal with the design of various machine elements, particularly those likely to be met with in chemical and metallurgical plants, and in mining work.

Text book: Machine Design—Berard & Waters.

470. Machine Design Laboratory. W. G. McIntosh, G. H. Hally.

Departments 2, 6, 8, and 8a, IV Year; 3 hrs. laboratory per week, second term.

The problems worked out in the laboratory are designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical and metallurgical apparatus, and mine machinery.

471. Elementary Machine Design. W. G. McIntosh.

Departments 1c and 1d, III Year; Department 5, II Year; 1 hr. lecture per week, both terms.

This course of lectures is intended to give some acquaintance with the selection of materials and their use in the design and construction of machinery. Machine parts are analysed as to suitable materials, production methods, and the nature and magnitude of the stresses encountered.

Text book: Machine Design—Berard and Waters.

472. Elementary Machine Design Laboratory. W. G. McIntosh, G. H. Hally.

Department 5, II Year; 3 hrs. laboratory per week, both terms.

Departments 1c and 1d, III Year; 2 hrs. laboratory per week, both terms.

The work in the laboratory will consist of the analytical solution of problems, illustrating the principles involved in the lecture course, and the standard practice in making assembly and detail machine drawings.

473. Advanced Machine Design. W. G. McIntosh.

Department 3, IV Year; 2 hrs. lectures per week, both terms.

This course of lectures deals with the design of machine frames, hooks, hoisting equipment, crankshafts, gears of various kinds (helical, herringbone, bevel, screw, worm), springs, clutches, brakes, thin and thick wall vessels. An introduction will be given to the study of dynamic problems conected with the motor car, Diesel engine, and other high speed machinery.

Text book: Design of Machine Elements—Faires.

474. Advanced Machine Design Laboratory. W. G. McIntosh, G. H. Hally.

Department 3; IV Year; 6 hrs. laboratory per week, first term; 8 hrs. laboratory per week, second term.

The work in the laboratory is devoted to the design of complete machines, with the object of giving the student practice not only in the design of various details, but also in working the various elements into a machine of smooth and harmonious design. The machines chosen as examples for design involve as many new machine elements as possible, in order to broaden the training of the student.

The work in the laboratory also involves special shafting problems, including graphical solutions, critical speeds, and multiple supports.

MATHEMATICS

490. Calculus. S. Beatty, D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell, R. H. Bruck.

Departments 1, 2, 3, 4, 6, 7, 8, 8a, and 9, I Year; 2 hrs. lectures per week, both terms.

Department 7, I Year, one 3 hr. period per week, both terms, for problems.

Derivation of the fundamental formulae of the differential and integral calculus, with early applications to simple problems concerning graphs, areas, volumes, lengths, centres of gravity, and moments of inertia. Problems are dealt with in the drafting room as outlined in courses 275, 276, 277, 278, 279, 280, 281, 282, and 283. For Department 7, an additional period of three hrs. per week is provided for problems and exercises, conducted by the Department of Mathematics.

491. Calculus. I. R. Pounder, D. A. F. Robinson, Miss M. E. G. Waddell, D. B. DeLury.

Departments 1, 3, 6, and 7, II Year; 2 hrs. lectures per week, both terms.

Department 7, II Year; one 3 hr. period per week, both terms, for problems.

Continuation of course 490. The elementary theory reviewed and extended. Special attention to applications with problems in engineering mostly in view. Introduction to the study of simple differential equations. Problems are dealt with in the drafting room as outlined in courses 284, 285, 286, 287, 288, and 289. For Department 7, an additional period of three hrs. per week is provided for problems and exercises, conducted by the Department of Mathematics.

492. Analytical Geometry. S. Beatty, D. A. F. Robinson, J. D. Burk, Miss M. E. G. Waddell, R. H. Bruck.

Departments 1, 2, 3, 4, 6, 7, 8, 8a, and 9, I Year; 1 hr. lecture per week, first term, 2 hrs. per week, second term.

The course in Elementary Analytical Geometry covers the more familiar propositions in connection with the straight line, circle, parabola, ellipse, and hyperbola. The subject is treated to illustrate the general methods of analytical geometry. In addition problems are dealt with in the drafting room as outlined in courses 275, 276, 277, 278, 279, 280, 281, 282, and 283. A part of the problem time for Department 7 listed under course 490 is devoted to problems in analytical geometry.

493. Spherical Trigonometry. J. W. Melson.

Department 1, II Year; 1 hr. lecture per week, first term.

A course of lectures including the derivation of formulae and their application to the solution of triangles and to practical problems.

Text book: Spherical Trigonometry—Todhunter and Leatham.

494. Least Squares. J. W. Melson.

Department 1, II Year; 1 hr. lectures per week, second term.

The course of lectures includes: The general principles of probability, the law of error, direct measurements of equal and different weights; mean square and probable errors; indirect measurements; conditioned observations; applications to empirical constants and formulae, etc.

Text book: Least Squares—Merriman.

MATHEMATICS, ADVANCED

Elective courses in Mathematics are offered to students of the I and II Years. Students of the I Year will be informed at the beginning of the fall term whether or not they are qualified to proceed with the advanced course. Those who take this course will try the ordinary pass examination papers, plus an advanced problem paper at the end of the year. The pass standing for proceeding to the Second Year will be determined by the ordinary paper, the marks of the problem paper being used to determine whether or not the student has shown sufficient proficiency to take the advanced work of the Second Year.

Students of the Second Year taking the advanced course will try the ordinary pass examination papers plus an advanced problem paper, pass standing being determined by the ordinary papers and proficiency for further advanced work by the problem paper.

Although these courses are entirely elective, students who are qualified to take them are urged to proceed with this work.

The names of those who pass these advanced papers will be published with the regular results each year as having completed these courses.

500. Advanced Mathematics. The Staff in Mathematics.

Departments 1, 2, 3, 4, 6, 7, 8, 8a, and 9, I Year; 3 hrs. lectures per week, first term; 4 hrs. lectures per week, second term.

Department 7, I Year, one 3 hr. period per week, both terms for problems.

In addition to the regular material included under courses 490 and 492, students will take work on advanced problems on conics; parametric equations of conics; curve tracing and asymptotes; circular and hyperbolic functions; expansions of functions of one variable; partial fractions; elementary theory of equations; determinants up to the third order; one-parameter families of curves and their differential equations; differential equations in elementary mechanics; curve fitting and approximate integration.

501. Advanced Mathematics. The Staff in Mathematics.

Departments 1, 3, 6, and 7, II Year; 2 hrs. lectures per week, both terms.

Department 7, II Year, one 3 hr. period per week, both terms for problems.

In addition to the regular material included under course 491, students will take work on elementary space geometry; partial differentiation; expansions of functions of more than one variable; multiple integration; ordinary differential equations of first order and first degree; linear differential equations with constant coefficients; applications to problems in mechanics.

502. Algebra and Calculus. I. Kaplansky.

Department 5, I Year; $3\frac{1}{2}$ hrs. lectures per week, both terms.

Polynomials and rational functions, elementary theory of equations, inequalities, determinants, limits, summation of series, binomial, exponential, and logarithmic series, expansions of the circular and hyperbolic functions and their inverses, the methods and operations of the Calculus considered intuitively and illustrated by applications, and elementary differential equations.

Text books. Introduction to the Calculus—Osgood. Introduction to the Calculus—Beatty and Jenkins.

503. Analytical Geometry of the Plane. I. Kaplansky.

Department 5, I Year; $1\frac{1}{2}$ hrs. lectures per week, both terms.

Cartesian and polar coordinates, transformation of coordinates, straight lines and curves of the second degree, projective properties of conics, the principle of duality, higher plane curves.

Text book: Analytical Geometry—Nowlan.

504. Differential Calculus. J. D. Barber.

Department 5, II Year; 3 hrs. lectures per week, both terms.

Differentiation, Taylor's theorem and series for functions of one or more variables, families of curves and surfaces and their differential equations, Jacobians, geometrical and mechanical applications.

Text books: Introduction to the Calculus—Osgood. Introduction to the Calculus—Beatty and Jenkins.

505. Integral Calculus and Differential Equations. J. D. Barber.

Departments 1c and 1d, III Year; Department 5, II Year; 3 hrs. lectures per week, both terms.

The indefinite integral, integration of rational and other special functions, the definite integral, differentiation with respect to a parameter, multiple integration, Fourier's series, geometrical and mechanical applications, approximate integration, introduction to ordinary differential equations.

Text books: Introduction to the Calculus—Osgood. Introduction to the Calculus—Beatty and Jenkins.

506. Analytical Geometry of Space. J. D. Barber.

Department 5, II Year; 1 hr. lectures per week, both terms.

Cartesian and other systems of point coordinates, curves and surfaces and their equations in parametric or non-parametric form, data fixing planes, lines, conics, and quadrics, generating lines and circular spectrons of quadrics, classification of quadrics, tangent cones to quadrics, metric and projective properties of quadrics, families of quadrics, ruled surfaces and surfaces of revolution.

Text book: Analytic Geometry—Nowlan.

507. Differential Equations. S. A. Jennings.

Departments 1c, 1d, and 5, III Year; 1 hr. lecture per week, both terms.

First order equations solvable by quadratures, depression of the order, the linear equation, systems of linear equations with constant coefficients, first order partial equations in two variables, total differential equations, particular equations of the second order.

Text books: Differential Equations—Piaggio. Differential Equations—Cohen.

508. Introduction to the Theory of Functions. S. A. Jennings.
Departments 1c, 1d, and 5, III Year; 1 hr. lecture per week, both terms.
Green's and Stokes's Theorems, conformal mapping of one plane region on another, the complex variable, analytical functions, Cauchy's Theorem and Integral Formula, Poisson's Formula, Taylor's and Laurent's series.
Text book: Theory of Functions—Rothe, Ollendorff, and Pohlhausen.

MATHEMATICS, APPLIED

520. Theoretical Mechanics. J. L. Synge.
Department 5, III Year; 1 hr. lecture per week, both terms.
The course deals with the dynamics of a particle on a curve and in two dimensions and the dynamics of rigid bodies in two-dimensional motion.
Text book: Dynamics—Lamb.

521. Differential Equations of Mathematical Physics. A. F. Stevenson.
Departments 1c, 1d, and 5, IV Year; 2 hrs. lectures per week, both terms.
The course deals with the underlying theory and with important particular equations, and includes eigenvalues and eigenfunctions, Fourier series, spherical and cylindrical harmonics, vibration of strings, membranes, and rods, sound waves, water waves, equation of heat conduction, perturbation theory, methods of Green.

522. Theory of Elasticity. J. L. Synge.
Department 1c, IV Year; 1 hr. lecture per week, both terms.
An introduction to the mathematical theory of elasticity.

523. Theoretical Hydrodynamics. J. L. Synge.
Department 5h, IV Year; 2 hrs. lectures per week, both terms.
The course deals with the theory of the motion of perfect and viscous fluids, including irrotational motion in two and three dimensions, vortices, discontinuous flow, aerofoil theory, simple cases of viscous flow.
Text book: Treatise on Hydromechanics, Part II—A. S. Ramsey.

524. Dynamics. B. A. Griffith.
Department 7, II Year; 1 hr. lecture, 1 hr. problems per week, both terms.
A course in theoretical dynamics, including the motion of a particle on a straight line and in a plane, simple harmonic motion, the circular pendulum, projectiles, centre of gravity, moments of inertia, motion of a rigid body about a fixed axis, impulsive motion, problems on rolling and sliding.
Text book: An Introduction to Mechanics—J. W. Campbell.

METALLURGY

530. Metallurgy, Elementary. G. A. Guess.

Departments 2, 3, 6, 8, 8a, and 9, II Year; 1 hr. lecture per week, second term.

A course of about 12 lectures on furnace metallurgy and present practice, with special reference to iron and steel.

531. Fuels and Combustion. G. A. Guess.

Department 8, II Year; 1 hr. lecture per week, both terms.

A lecture course dealing with fuels, their use, preparation, caloric value and combustion.

532. Metallurgy. G. A. Guess.

Departments 2, 6, 8a, and 9, III Year; 1 hr. lecture per week, both terms.

Fuels, temperature of combustion, specific heat, conductivity, and problems thereon; chimneys, furnaces, refractories, outline of furnace metallurgy and hydro-metallurgy.

533. Physical Metallurgy. J. A. Newcombe.

Departments 3, 5, 6, 7, and 8a, III Year; 2hrs. lectures per week, second term.

A course on general physical metallurgy, including the common engineering alloys.

534. Metallurgy. G. A. Guess.

Department 8, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

A lecture course on general metallurgy.

535. Metallurgy Laboratory. J. E. Toomer.

Department 8, III Year; 3 hrs. laboratory per week, first term; 6 continuous laboratory hrs. per week, second term.

Experiments in roasting, smelting, leaching, and retorting.

536. Physical Metallurgy. J. A. Newcombe.

Department 8, III Year; 1 hr. lecture per week, both terms.

The physical metallurgy of the common alloys; equilibrium diagrams. Pyrometry.

537 Metallogaphy Laboratory. J. A. Newcombe.

Department 8, III Year; 3 hrs. laboratory per week, first term.

The use of the microscope. The preparation of alloys. Pyrometry.

538. Metallurgy. G. A. Guess.

Departments 2 and 6m, IV Year; 1 hr. lecture per week, both terms.

General metallurgy and metallurgical problems.

539. Metallurgy Laboratory. J. E. Toomer.
Departments 2 and 6m, IV Year; 6 continuous hrs. laboratory per week, second term.
The course is similar to course 535.

540. Metallurgy Problems. G. A. Guess.
Department 8, IV Year; 2 hrs. lectures per week, both terms.
Metallurgical book-keeping, balance sheets, thermal balance sheets, methods, and processes.

541. Metallurgy Laboratory. J. E. Toomer.
Department 8, IV Year; 4 hrs. laboratory per week, both terms.
Metallurgical analyses of ores, furnace products, and alloys.

542. Metallurgy. G. A. Guess.
Department 8, IV Year; 1 hr. lecture per week, both terms.
Critical reading and discussion of papers and articles, describing metallurgical processes or dealing with plant arrangement and construction. Metallurgical flow sheets of typical plants.

543. Physical Metallurgy. J. A. Newcombe.
Departments 6m and 8, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
A continuation of the lectures of course 536, dealing more particularly with the ferrous alloys. Part of the lecture course consists of discussions of photo-micrographs.

544. Metallography Laboratory. J. A. Newcombe.
Departments 6m and 8, IV Year; 3 hrs. laboratory per week, both terms.
Specimens of the common alloys are prepared, microscopically examined, and photographed.

545. Physical Metallurgy. J. A. Newcombe, W. L. Sagar.
Department 8, IV Year; 3 hrs. laboratory per week, first term.
The introductory part of this course is intended to give some familiarity with the experimental study of the elastic and physical properties of iron and steel, and in the use of testing machines and instruments of precision designed for that purpose. Following this, carbon and alloy steels are given different heat treatments. The structures developed are examined and photographed, mechanical tests are made and findings correlated.

546. Physical Metallurgy. J. A. Newcombe.
Department 1, II Year; 1 hr. lecture per week, second term.
The physical properties of metals and alloys used in civil engineering practice.

547. Heat Treatment of Iron and Steel. J. A. Newcombe.
Department 3, IV Year; 1 hr. lecture per week, both terms.
The principles underlying the heat treatment and mechanical treatment of carbon and alloy steels. Cast iron.

548. Heat Treatment of Iron and Steel Laboratory. J. A. Newcombe.
Department 3, IV Year; $1\frac{1}{2}$ hrs. laboratoy per week, second term.
The laboratory course will consist of preparation of specimens of steels and irons, and examining them microscopically.

CERAMICS AND NON-METALLIC MINERALS

560. Non-Metallic Minerals. R. J. Montgomery.
Department 8a, III Year; Department 6c, IV Year; 4 hrs. lectures per week, first term; 2 hrs. lectures per week, second term.
Lectures covering the industrial classification, properties, and utilization of non-metallic minerals. Ceramic plant practice is covered in some detail in the second term.

561. Non-Metallic Minerals Laboratory. R. J. Montgomery.
Department 8a, III Year; Department 6c, IV Year; 6 hrs. laboratory per week, first term; 9 hrs. laboratory per week, second term.
The physical properties and thermal characteristics of non-metallic minerals are studied from an industrial standpoint.

562. Ceramics. R. J. Montgomery.
Department 8a, III Year; 2 hrs. lectures per week, second term.
Lectures are given on the composition of clear and coloured glazes.

563. Ceramic Calculations. J. E. Toomer.
Department 8a, IV Year; 1 hr. lecture per week, first term.
Lectures and problems on calculations necessary for the compounding of ceramic bodies and glazes.

564. Non-metallic Minerals Laboratory. J. E. Toomer.
Department 8a, IV Year; 6 hrs. laboratory per week; first term, 3 hrs. laboratory per week, second term.
Laboratory practice in the analysis of non-metallic minerals.

565. Refractories and Ceramic Bodies. R. J. Montgomery.
Departments 6c and 8a, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
Lectures on the composition of bodies made by using non-metallic minerals, with special reference to refractories, whiteware, and porcelain.

566. Glass and Enamels. R. J. Montgomery.
Department 8a, IV Year; 1 hr. lecture per week, both terms.
Lectures on the composition and manufacture of glass and iron enamels.

567. Non-Metallic Mineral Products. R. J. Montgomery.
Department 8a, IV Year; 1 hr. lecture per week, both terms.
Lectures on specifications, testing, and methods of testing non-metallic mineral products.

568. Industrial Minerals Laboratory. R. J. Montgomery.

Department 8a, IV Year; 6 hrs. laboratory per week, both terms.

Advanced work on the compounding and testing of non-metallic mineral products.

569. Ceramic Building Materials. R. J. Montgomery.

Department 4, IV Year; 1 hr. lecture per week, second term.

Lectures on the composition, manufacture, properties, and use of ceramic building materials.

MINERALOGY

580. Elementary Mineralogy. J. E. Thomson.

Departments 6, 8, and 8a, I Year; 2 hrs. lectures per week, first term.

After introducing the student to the chief chemical, physical, and crystallographic characteristics of minerals, the course becomes descriptive and deals with about one hundred of the minerals most important from the industrial or scientific point of view.

Text book: Text-book of Mineralogy—Dana.

581. Mineralogy. J. E. Thomson.

Departments 2 and 9, I Year. Twenty-five lectures. 2 hrs. lectures per week, first term and part of second term.

After introducing the student to the chief chemical, physical, and crystallographic characteristics of minerals, the course deals with about one hundred and twenty-five of the minerals most important from the industrial or scientific point of view, laying particular emphasis on their paragenesis and alteration.

Text book: Text-book of Mineralogy—Dana.

582. Primary Mineralogy. V. B. Meen.

Department 1, II Year; 2 hrs. lectures per week, first term.

A very brief introduction to the study of minerals and rocks.

Text books: Minerals and How to Study Them—Dana. Handbook of Rocks—Kemp.

583. Mineralogy. J. E. Thomson.

Departments 2 and 9, I Year; 1 hr. laboratory per week, both terms.

Determination of minerals by inspection and by means of physical tests.

Text book: Mineral Tables—Eakle.

584. Mineralogy Laboratory. J. E. Thomson.

Departments 8, and 8a, I Year; 1 hr. laboratory per week, first term.

Determination of minerals by inspection and by means of physical tests.

Text book: Mineral Tables—Eakle.

585. Mineralogy Laboratory. J. E. Thomson.
Department 6, I Year; 1 hr. laboratory per week, both terms.
Determination of minerals by inspection and by means of physical tests.
Text book: Mineral Tables—Eakle.

586. Mineralogy Laboratory. V. B. Meen.
Department 1, II Year; 1 hr. laboratory per week, first term; 2 hrs. per week, second term.
Determination of minerals by inspection and by means of physical tests; study of common rock types and their identification.
Text books: Mineral Tables—Eakle. Handbook of Rocks—Kemp.

587. Elementary Petrography. J. E. Thomson.
Departments 5g and 8a, III Year; 1 hr. lecture and laboratory per week, both terms.
A course of lectures and laboratory work introducing the student to the macroscopic study of rocks.
Text book: Handbook of Rocks—Kemp.

588. Elementary Petrography. J. E. Thomson.
Departments 2 and 9, I Year. Twenty-five hours; 2 hrs. lectures and laboratory per week, second term, following course 581.
A course of lectures and laboratory work introducing the student to the macroscopic study of rocks.
Text book: Handbook of Rocks—Kemp.

589. Mineralogy. J. E. Thomson.
Departments 2 and 9, II Year; 2 hrs. laboratory per week, both terms.
Determination of minerals by means of the blow-pipe and physical properties.
Text book: Determinative Mineralogy and Blowpipe Analysis—Brush-Penfield.

590. General Petrography. A. L. Parsons.
Departments 2 and 9, III Year; Departments 5g and 8a, IV Year; 1 hr. lecture per week, both terms.
Study of the chief rock-forming minerals and of some phases of petrography not covered in the course of the previous year.
Text books: Petrology for Students—Harker. Thin Section Mineralogy—Rogers and Kerr.

591. Petrography Laboratory. V. B. Meen.
Departments 2 and 9, III Year; Departments 5g and 8a, IV Year; 2 hrs. laboratory per week, both terms.
Study of the chief rock-forming minerals, of rocks in thin sections and in hand specimens.
Text books: Petrology for Students—Harker. Thin Section Mineralogy—Rogers and Kerr.

592. Optical Mineralogy Laboratory. M. A. Peacock.
Department 9, IV Year; 2 hrs. laboratory per week, both terms.
The study of non-opaque minerals by the immersion method.
Reference book: The Microscopic Determination of the Non-opaque Minerals—Larsen & Berman (1934).

593. Mineralography. J. E. Thomson.
Department 9, IV Year; 2 hrs. laboratory per week, both terms.
The study of opaque minerals by microscopic methods with reflected light.
Reference book: Determination of the Opaque Minerals—Farnham.

594. Morphological Crystallography. M. A. Peacock.
Department 5s, IV Year; 1 hr. lecture per week, both terms.
A study of the forms of natural and artificial crystals.
Reference books: Crystallography—Tutton. Dana's Text-book of Mineralogy—Ford.

MODERN LANGUAGES

610. Technical English. W. J. T. Wright.
Departments 1, 2, 3, 4, 6, 7, 8, 8a, and 9, I Year; 1 hr. lecture per week, both terms.
A lecture course on the expression of ideas and the compilation and writing of engineering reports and letters; technical exposition; the necessity of accurate expression in professional writing; the value of reading.

611. English. W. J. T. Wright.
Department 4, II Year; 1 hr. lecture per week, both terms.
This course of lectures includes a discourse on the literature which refers either directly or indirectly to architecture and the arts. Books are reviewed and discussed in round-table talks.

612. German. H. Boeschenstein.
Department 6, I Year; 2 hrs. lectures per week, both terms.
An introduction to German grammar, and practice in reading elementary German.

613. German. H. Boeschenstein.
Department 6, II Year; 1 hr. lecture per week, both terms.
An intermediate course in scientific German.

614. German. H. Boeschenstein.
Department 6, III Year; 1 hr. lecture per week, both terms.
An advanced course in scientific German.

615. German. H. Boeschenstein.
Department 6, IV Year; 1 hr. lecture per week, both terms.
An advanced course in scientific German, and translation of scientific articles and treatises.

616. German. C. Barnes.

Department 5, I Year; 2 hrs. lectures per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: First German Course for Science Students—Fiedler and Sandbach.

617. German. C. Barnes.

Department 5, II Year; 1 hr. lecture per week, both terms.

An elementary course intended to train the student in the translation of scientific journals and treatises.

Reference book: Second German Course for Science Students—Fiedler and Sandbach.

618. French. Miss J. C. Laing.

Department 4, I Year; 2 hrs. lectures per week, both terms.

Outline of the History of France with reference to the development of French civilization, particularly architecture.

Text book: Michelet's Histoire de France—Buffum.

619. French. Miss J. C. Laing.

Department 4, II Year; 1 hr. lecture per week, both terms.

Continuation of the history from the I Year. Reading of typical examples of French literary forms, Villon to Molière.

Reference books: The Renaissance and the Reformation—Lucas. A Political and Cultural History of Modern Europe, Vol. 1—Hayes. A ShortHistory of France,National History of France, The Century of the Renaissance—Batiffol. The Seventeenth Century—Boulenger.

620. Spanish.

Department 6, IV Year; 1 hr. lecture per week, both terms.

An introduction to Spanish grammar, pronunciation, and practice in reading Engineering Spanish.

MUNICIPAL ENGINEERING

630. Sanitary Engineering. A. E. Berry.

Department $1a_1$, IV Year; 1 hr. lecture per week, both terms.

Consideration is given to the problems of water supply, sewerage, and municipal sanitation as viewed by the engineer. This course includes the design of water distribution and sewer systems, as well as water and sewage treatment works. Problems are assigned, from assumed data and from material secured in the field, to be worked out in the drafting room under course 301.

Reference books: Manual of Water Works Practice of the American Water Works Association. Elements of Water Supply Engineering—Waterman. Water Supply and Sewerage—Steel. American Sewerage Practice (3 Vols.)—Metcalfe and Eddy. Solving Sewage Problems—Fuller and McClintock.

631. Highway Engineering. W. L. Sagar.

Department $1a_1$, IV Year; 1 hr. lecture per week, second term.

This course of lectures deals with the fundamentals of highway engineering. It includes a consideration of the types and properties of the materials employed, location, curves and grades, airport and highway drainage, theory of soil stabilization, design of pavements of both the flexible and rigid types, and airport runways.

632. Highway Engineering. W. L. Sagar.

Department $1a_1$, IV Year; 3 hrs. laboratory per week, second term.

This course includes the determination of the physical properties of subsoil, bituminous and non-bituminous materials of construction, interpretation of test results, specifications, the design of soil and bituminous paving mixtures.

Reference books: Construction of Roads and Pavements—Agg. Rural Highway Pavements—Harger. Principles of Highway Engineering—Wiley. Public Roads—U.S.D.A. Specifications—Department of Highways, Ontario

PHYSICAL TRAINING

640. Physical Training. G. D. Porter.

All Departments, I and II Years, and optional in III and IV Years.

By order of the Board of Governors each man proceeding to a Bachelor's degree must take Physical Training during the first and second years of his attendance. In each session in which Physical Training is compulsory, he must first undergo a medical examination by the Director of the University Health Service, and must then register for Physical Training at the office of the Athletic Association in Hart House. Students of all years who wish to take part in any form of athletics or physical exercise, must first undergo a medical examination by the Director.

The student who has failed to complete satisfactorily the course in Physical Training prescribed for the First Year, will not be permitted to register in the Third Year; and the student who has failed to complete satisfactorily the course in Physical Training prescribed for the Second Year, will not be permitted to register in the Fourth Year.

The student who has neglected to complete satisfactorily the course in Physical Training of the First or Second Year, must take this work during the Second or Third Year respectively of his attendance, and will be required to pay a supplemental fee of ten dollars in addition to the prescribed Physical Training fee.

Military training in the C.O.T.C. constitutes an option in Physical Training (see page 181).

PHYSICS

650. Properties of Matter, Mechanics, and Heat. John Satterly.

Department 5, I Year; 3 hrs. lectures, per week, both terms.

In addition to the work in the divisions indicated in the title, the course also includes lectures and problems on calculations for science students involving the use of the elementary calculus and statistics. The course is planned in conjunction with the work taken under the title of Engineering Mechanics.

Reference books: Dynamics—Duncan and Starling. Heat—Gray. Analytical Mechanics—Barton. Mechanics of Fluids—Barton. Properties of Matter—Wagstaff. Heat—Stewart and Satterly. Heat—Draper. Mathematical and Physical Tables—Clark. Calculus made easy—Thompson. Theory of Measurements—Tuttle and Satterly.

651. Properties of Matter, Mechanics, and Heat. Laboratory. John Satterly.

Department 5, I Year; 4½ hrs. laboratory per week, both terms.

A laboratory course supplementary to course 650.

652. Elementary Magnetism and Electricity. L. Gilchrist.

Department 5, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

This course deals with the fundamental theory of magnetism and electricity, including the introduction of electron theory and alternating currents.

Reference books: Advanced Text-book of Magnetism and Electricity—Hutchinson. A treatise on Electricity—Pidduck. Electricity and Magnetism—Starling. Mathematical Physics, Vol. I—Barlow.

653. Elementary Light. H. A. McTaggart.

Department 5, II Year; 1 hr. lecture per week, both terms.

This course deals with the fundamental theory of light, including treatment of interference, diffraction, polarized light, and the introduction of geometrical optics.

Reference books: Light for Students—Edser. Introduction to Physical Optics—Robertson. Optical Measuring Instruments—Martin.

654. Acoustics. E. F. Burton.

Department 5, II Year; 1 hr. lecture per week, first term.

This course deals with the fundamental theory of acoustics, including stationary waves and elementary treatment of architectural acoustics and sound transmission.

Reference books: Science of Musical Sounds—D. C. Miller. Speech and Hearing—Fletcher. Sound—A. B. Wood. Acoustical Engineering—West. Sound—F. R. Watson.

655. Physics Laboratory (Magnetism and Electricity, Light, and Acoustics).

Department 5, II Year; 3 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

This laboratory work is carried out under the direction of the staff in Physics and covers lectures dealt with in courses 652, 653, and 654.

656. Mathematical Operations Applied to Physics. C. Barnes.

Departments 5c, 5s, 5h, and 5i, III Year; IV Year, (1939-40 only); 1 hr. lecture per week, both terms.

This course involves an account of vectors illustrated by the application of vector algebra to physical problems, and an elementary treatment of such things as Fourier Series and Spherical Harmonics.

657. Properties of Matter. John Satterly.

Department 5, III Year; 2 hrs. lectures per week, both terms.

This course involves advanced work on properties of matter, dealing very intensively with gravitation, elasticity, viscosity, surface tension, and kinetic theory of gases.

Reference books: Properties of Matter—Poynting and Thomson. General Properties of Matter—Newman and Searle. Applied Mathematics—Perry. Experimental Physics—Searle. Practical Physics—Watson. The Mechanical Properties of Fluids—Drysdale and others.

658. Heat. John Satterly.

Department 5, III Year; 1 hr. lecture per week, both terms.

A study of thermometry and pyrometry, the absolute scale of temperature, the mechanical equivalent of heat, the kinetic theory of gases, equations of state, low temperature work, specific heats, vaporization, fusion, expansion, transfer of heat by conduction and convection; radiation and radiation pyrometry, the second law of thermodynamics and its simple applications.

Reference books: Heat and Thermodynamics—Roberts. Methods of Measuring Temperature—E. Griffiths.

659. Physical Laboratory.

Department 5, III Year; 3 hrs. laboratory per week, both terms.

This laboratory work includes experiments illustrating the principles involved in the four preceding courses.

660. Optics. H. A. McTaggart, K. B. Jackson.

Departments 5c, 5s, 5g, and 5i, III Year; 1 hr. lecture per week, both terms.

This course deals with geometrical and physical optics and photometry as applied to optical instruments, and with photography as a scientific implement.

Reference books: Optical Measuring Instruments—Martin. Photometry—Walsh.

661. Optics. H.A. McTaggart, K. B. Jackson.

Departments 5c, 5s, 5g, and 5i, III Year; 3 hrs. laboratory per week, both terms.

This laboratory course is supplementary to course 660.

662. Hydrodynamics. H. A. McTaggart.

Departments 1d, and 5h, III Year; 1 hr. lecture per week, both terms.

A lecture course for beginners on the hydrodynamics of a perfect fluid with applications to motion in liquids and gases. Reference will be made to some of the simpler cases of viscous flow. The course will be illustrated by experiments.

Text books: Treatise on Hydromechanics—Ramsay. Aerofoil and Airscrew Theory—Glauert. The Physics of Solids and Fluids—Ewald, Poschl and Prandtl. Hydro and Aeromechanics—Prandtl-Tietjens.

663. Conduction through Gases, Radioactivity, and Atomic Structure. John Satterly.

Departments 5c and 5s, IV Year; 1 hr. lecture per week, both terms.

Kinetic theory of gases, electrical discharge through gases, the electron, elementary X-rays and crystal structure, ionization, the development of radioactivity and its use in the physical and geological sciences.

Text book: Ions, Corpuscles and Ionizing Radiations—Crowther.

Reference books: The Atom—Andrade. Radioactivity—Chadwick. Radioactivity—Rutherford. Heat—Poynting and Thomas.

664. Advanced Acoustics. C. Barnes.

Departments 5c, 5s, and 5i, IV Year; 1 hr. lecture per week, first term.

This course deals with the properties and transmissions of acoustical waves. It will bring out the analogies in alternating current theory and other fields in physics. Sound resonance and sound filters.

Text books: Acoustics—Stewart and Lindsay. Applied Acoustics—Olson and Massa. Acoustical Engineering—West.

665. Physical Laboratory. H. J. C. Ireton.

Department 5c, IV Year; 3 hrs. laboratory per week, both terms.

Department 5s, IV Year; 9 hrs. laboratory per week, both terms.

This laboratory course is designed to accompany the lecture courses 663, 664, 666, 667, and 669.

666. Advanced Optics. H. A. McTaggart, M. F. Crawford.
Department 5s, IV Year; 1 hr. lecture per week, both terms.
A lecture course on the principles and applications of various types of spectroscopic instruments. Interference, diffraction, and polarisation; refractometers and polarimeters.
Text books: Applied Optics—Martin. Course d'Optique—Bruhat. The Diffraction of Light, X-Rays, etc.—Meyer. Applied Optics and Optical Design—Conrady.

667. Series Spectra. H. J. C. Ireton.
Department 5s, IV Year; 1 hr. lecture per week, second term.
A lecture course outlining the early developments in atomic spectroscopy, the origin of spectral lines, and their empirical classification into series. The application of the derived formulae to hydrogen, helium, and the alkali metals is given.
Reference books: Introduction to Modern Physics—Richtmeyer. Introduction to Atomic Spectra—White.

668. Elementary Quantum Theory. Miss E. J. Allin.
Department 5s, IV Year; 1 hr. lecture per week, second term.
The fundamental principles of the quantum theory developed from a historical and experimental standpoint, radiation formulae, photoelectric effect, Compton effect, specific heats.
Reference book: Théorie des Quanta—Bloch.

669. X-Rays and Crystal Structure. H. J. C. Ireton, J. O. Wilhelm.
Department 5s, IV Year; 1 hr. lecture per week, both terms.
The fundamental physical principles of X-rays, their production, properties, and applications to the study of crystalline structure. The practical significance of the results obtained is outlined.
Reference books: The Crystalline State—Bragg and Bragg. Applied X-rays—Clark.

670. Geophysics. L. Gilchrist.
Departments 5g and 9, IV Year; 2 hrs. lectures per week, both terms.
The course involves a study of the physical principles underlying the methods of investigating surface geological structure and the location of mineral deposits. Particular attention is given to magnetic, electrical, electromagnetic, gravitational, seismological, thermometric, and radioactive methods of investigation.
Reference books: A Manual of Seismology—Davison. Modern Seismology—Walker. Lehrbuch der Geophysik—Gutemberg. Elements of Geophysics—Ambronn. Applied Geophysics—Eve and Keys. Geophysical Prospecting, 1929—A.I.M.E. Geophysical Prospecting, 1932—A.I.M.E. Geophysical Prospecting, 1934—A.I.M.E. Publications of Geological Survey, Department of Mines, Ottawa, Memoirs, 165, 170.

671. Geophysics. L. Gilchrist.

Department 5g, IV Year; 9 hrs. laboratory per week, both terms.

Department 9, IV Year; 6 hrs. laboratory per week, both terms.

A laboratory course supplementary to course 670; experiments which are illustrated with the methods of the lecture course are carried out, and typical problems are investigated.

672. Wave Motion in Elastic Media. L. Gilchrist.

Department 5g, IV Year; 1 hr. lecture per week, both terms.

The course involves the development of the differential equations for the propagation of various types of disturbance through different media. A study is made of the solution of these equations, having regard to the initial and final conditions and the boundary conditions of the media associated with the propagation of the disturbance. Typical problems are considered, such as (*a*) the propagation of vibrations in strings, rods, membranes, and plates, (*b*) the propagation of heat and electricity in planes, cylinders, and spheres.

Reference books: Fourier's Series and Spherical Harmonics—Byerly. Spherical Harmonics—MacRobert.

673. Physics of Light Production. H. J. C. Ireton.

Department 5i, IV Year; 1 hr. lecture per week, both terms.

A course of lectures dealing with black body radiation, spectral energy distribution, and the principles involved in the production of light in various types of sources, filament, flame, gaseous, and vapour tubes.

674. Physical Laboratory. H. J. C. Ireton.

Department 5i, IV Year; 3 hrs. laboratory per week, both terms.

A laboratory course to accompany course 673.

PRACTICAL EXPERIENCE

690. Summer Letters. C. G. Williams.

Department 2, III Year.

This is a series of letters written during the summer vacation, dealing with various aspects of a mining engineer's work. These are intended to direct and help the student's powers of observation, analysis, and criticism, as well as being exercises in the art of lucid technical expression.

Special instructions will be issued in connection with these letters.

691. Summer Letters. C. G. Williams.

Department 2, IV Year.

Special instructions will be given in connection with this work.

692. Shop Work. W. G. McIntosh.

Department 3, III Year; 600 hrs.

The student is required to obtain this practical experience in industry, preferably in the foundry, the forge shop, and the machine shop. Such work assists the student in his understanding of the lecture and laboratory work throughout his entire course in Mechanical Engineering, and particularly the design work in his Third and Fourth Years.

Instruction regarding the type of work which is acceptable, and any special requirements, will be given to the student during his Second Year.

693. Shop work. W. G. McIntosh.

Department 3, IV Year; the balance of 1200 hours.

This is a continuation of the work outlined for the Third Year, course 692.

Instruction regarding the type of work which is acceptable, and any special requirements, will be given to the student during his Third Year.

694. Vacation Work. H. H. Madill.

Department 4, II Year.

Each student is required to submit, on or before the opening day of the session, a set of twenty pages of notes on building construction. These notes are to consist of freehand pencil drawings with figured dimensions. Instruction as to the nature of these notes will be given by Professor Madill before the close of the previous session.

695. Vacation Work. E. R. Arthur.

Department 4, III Year.

Each student is required to submit, not later than the opening day of the session, a set of measured drawings of an existing building, along with the record of measurements and sketches neatly arranged in a note book. The subject must be approved before measuring is begun.

696. Vacation Work. H. J. Burden, W. E. Carswell.

Department 4, IV Year.

Each student is required to submit, on or before the opening day of the session, a set of at least seven outdoor sketches in water colour, pen and ink, or pencil. The minimum size for each sheet will be $9'' \times 12''$. Of these sketches at least four will be in pencil and at least three will be of an architectural character.

697. Practical Experience.

Department 7.

Each student registered in the Department of Electrical Engineering is required to submit to the Department, not later than January 15th in each session, certificates and a detailed report regarding practical experience. Certificate forms, the nature of the report, and information regarding the kinds of experience to be sought, may be obtained from the Department.

SURVEYING

710. Surveying. S. R. Crerar.

Departments 1, 2, and 9, I Year; 1 hr. lecture per week, both terms.

Departments 3, 7, 8, and 8a, I Year; 1 hr. lecture per week, first term.

The lecture course includes the general principles and practice of surveying with the chain, the transit, and the level, with special attention given to co-ordinative surveying.

Text books: Plane Surveying—Tracy. Elementary Surveying—Breed and Hosmer.

711. Surveying. T. L. Rowe.

Department 4, I Year; 1 hr. lecture per week, first term.

The lecture course includes the general principles and practice of surveying with the chain, the transit, and the level, with special consideration given to the survey of lots and small estates.

712. Field Work. S. R. Crerar, J. W. Melson, T. L. Rowe.

Departments 1, 2, and 9, I Year; 6 hrs. per week, first term.

Departments 3, 7, 8, and 8a, I Year: 6 hrs. per week to December 1.

This course comprises practice in chaining; a complete survey of a piece of land with the chain and transit; keeping of field notes; the use of the transit in surveying closed figures and traverse lines, and in ranging straight lines; plotting by latitudes and departures and otherwise computing areas; instrumental work with the level; also use of level and transit in setting out a proposed building and calculating the volume of excavations required.

713. Field Work. T. L. Rowe.

Department 4, I Year; 3 hrs. per week, first term.

This course comprises practice in chaining, a complete chain survey of a small estate, keeping field notes, the use of the transit and level and their application in building layouts, cross-section work with the level, including calculation for excavations.

714. Surveying. W. M. Treadgold.

Department 1, II Year; 1 hr. lecture per week, both terms.

This course of lectures takes up in detail, simple, reverse, and compound curves as applied to railroad and highway surveying. It also includes stadia, plane table, and photographic surveying as applied to topographic work, and the main features of mine, hydrographic, and aerial surveying.

Text books: Henck, Searles, Allen (Field books for Engineers). Theory and Practice of Surveying—Davis, Foote and Rayner. Surveying—Breed and Hosmer.

715. Surveying. E. W. Banting.

Departments 2 and 9, II Year; 1 hr. lecture per week, both terms.

This course of lectures takes up mine surveying, with problems related thereto. It also includes simple curves, stadia and plane table topographical surveying.

Text books: Surveying—Breed and Hosmer. Mine Surveying Durham.

716. Field Work. W. M. Treadgold, E. W. Banting.

Department 1, II Year; 9 hrs. per week, first term.

Departments 2 and 9, II Year; 6 hrs. per week, first term.

This course of instruction embraces all adjustments of the transit and level, minor problems in triangulation and traversing, levelling and plane table practice, curves and topography.

717. Surveying. W. M. Treadgold.

Departments 1a, 1b, and 1c, III Year; 1 hr. lecture per week, both terms.

This course of lectures takes up the work of the railroad engineer on construction, including profiles, cross-sectioning, computation of volume of earthwork, overhaul, transition curves, laying out turnouts, frogs, switches, etc.; also a discussion of trigonometric and barometric levelling.

Text books: Field Engineering—Searles. Railroad Curves and Earthworks—Allen. Route Surveying—Pickles and Wiley.

Photographic Surveying. See courses 81, 82, 83, and 84.

718. Survey Camp. W. M. Treadgold, S. R. Crerar, E. W. Banting, J. W. Melson, E. S. Moore.

Departments 1, 2, and 9, III Year; Department 1b, IV Year.

This course includes:

(*a*) Secondary Triangulation and Base Line Measurements.
(*b*) Stadia, Plane Table and Boundary Traverses.
(*c*) Highway and Railway Location.
(*d*) Cross Sectioning and Computation of Earthwork.
(*e*) Stream Gauging and Discharge Measurements.
(*f*) Hydrographic Surveying.
(*g*) Photographic and Micrometer Work.

(*h*) Stadia and Plane Table Topography.

(*i*) Mine Surveying.

(*j*) Observations for Time, Azimuth, and Latitude.

(*k*) Geological Survey.

A complete field course in Practical Astronomy and Geodesy is given to students taking this option in the Fourth Year, Department of Civil Engineering, including the adjustment of a triangulation, observations for time, latitude, and azimuth, and base line measurements.

Students in Departments 1, 2, and 9 will be required to take the Survey Camp between the Second and Third Years; on failure to do so, this subject will be carried as a supplemental in the Third Year.

THESIS

730. Thesis.

Department 1, IV Year.

Each student of the Fourth Year, Department 1, will be required to prepare and present a thesis on an approved subject, in both oral and written form.

731. Thesis.

Department 2, IV Year; 7 hrs. per week, first term; 10 hrs. per week, second term, in continuous periods.

The thesis in this department consists mainly of reports on original work done in the laboratories. In the Third Year the subject "Introductory Research" paves the way for the thesis. By October 15th the student decides on the subject of his thesis, in consultation with his professors. After this is decided the student uses his own initiative in the development of his work.

The thesis is divided into three parts. The first part, which is handed in not later than October 15th, contains the title, a statement of what the title is meant to convey, and an outline of the work proposed to be done. The second part is handed in during the first week of January, and contains a report of progress to date; it also enables the professor in charge to keep in closer touch with the work. The third and final part is handed in a week before the examinations, and is a report of progress to date with final conclusions. The three parts combined constitute the thesis.

732. Thesis.

Department 3, IV Year.

Printed instructions regarding thesis requirements are issued to each student by the Department of Mechanical Engineering, giving full particulars.

733. Thesis.

Department 5, IV Year.

Each student in the Fourth Year, Departments 5c, 5s, and 5h, will be required to prepare a thesis on an approved subject.

734. Thesis.

Department 6, IV Year.

The thesis describes the research work carried on by the student during four and a half months of the session. It must be typewritten on unruled $8\frac{1}{2}'' \times 11''$ paper, accompanied by graphs and photographs where necessary. The unbound sheets are handed to the Department about April 15th, and are bound in board covers by the University Press.

735. Thesis.

Department 7, IV Year.

Each student is required to prepare a thesis on a subject approved by the Head of the Department of Electrical Engineering. Instructions regarding the form of the thesis will be given to the students at the end of the Third Year.

736. Thesis.

Department 8, IV Year.

Each student in the Fourth Year must prepare a thesis on a subject and in a form approved by the head of the Department.

The most usual type of thesis is on the result of extended search and reading in a specialized field of metallurgical theory or practice.

737. Thesis.

Department 8a, IV Year.

The thesis consists of a written report of approximately 6,000 words, on a subject approved by the Department. Material for this report is obtained from laboratory and library work, which is carried out under the supervision of a member of the staff.

738. Thesis.

Department 9, IV Year; 6 hrs. per week, both terms.

The thesis will consist of a report on an investigation made by the student. It is intended to test his ability to make an independent field or laboratory study of some geological problem. The problem chosen must be approved by the head of the Department of Geology, and plans for the thesis completed not later than November 1st of the student's Fourth Year.

ZYMOLOGY

750. Zymology. A. M. Wynne.

Department 6z, IV Year.

A study of the phenomena of fermentation and of the mechanism of enzyme action.

SECTION X. EXAMINATIONS

ANNUAL

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in all subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations are 50 per cent. in the Department of Engineering Physics and 40 per cent. in all other Departments, with an average of 50 per cent. The pass marks required in the laboratory work of all Departments are 60 per cent. In the Department of Engineering Physics an average of 60 per cent. will be required in the written and practical work of the Second, Third, and Fourth Years. Candidates who have attained the required average and who have failed in not more than two subjects will be required to pass supplemental examinations in those subjects to secure pass standing.

5. Honours will be granted to students who, at the annual examinations, obtain at least 50 per cent. in each written subject, at least 60 per cent. in each laboratory subject, and 75 per cent. of the total number of marks allotted to the subjects of their course.

6. Honour graduate standing will be granted to those who obtain honours in the final year and in one previous year.

7. Candidates who fail to secure promotion in any year will be required to take again the whole course of instruction in the year in which they fail before presenting themselves a second time for examination.

8. A student failing in the First or Second Year of the Department of Engineering Physics will not be permitted to repeat the year in this Department.

9. A student who, in either term of the session, fails to perform satisfactorily the work of his course may not be allowed to present himself at the final examinations of the year.

10. A student should submit to Council immediately after its occurrence, evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day of examinations.

11. A student who has failed to complete satisfactorily the course in

Physical Training prescribed for the First Year will not be permitted to register in the Third Year; and a student who has failed to complete satisfactorily the course in Physical Training prescribed for the Second Year will not be permitted to register in the Fourth Year.

12. A student will not be allowed to write any examinations if he has not paid all fees and dues for which he is liable at that time.

13. Unless special permission is granted by the Council of the Faculty concerned, a student will not be permitted further registration in the University if, at the end of two sessions spent in the same year of the Faculty in which he is registered, he has failed to obtain the standing necessary to qualify him for registration in the succeeding year of the Faculty. An appeal from the decision of the Faculty Council may be made to the Senate.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on the 12th day of September, 1939. Application (on the prescribed form) to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 15th, and the fee named in Sec. VI, para. 5, received by the Bursar not later than September 1st. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements. Arrangements will be made to conduct supplemental examinations at the Survey Camp for those students in attendance at the Camp.

2. If a candidate desires to write upon an annual examination as a supplemental, his application must be received by the Secretary and his fee by the Bursar, for the January examinations not later than December 1st and for the April examinations not later than March 1st.

3. Pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

4. Under special circumstances, a candidate who has failed to obtain pass marks in one written supplemental examination may, at the discretion of Council, be permitted to enter the next higher year.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

SECTION XI. SCHOLARSHIPS

Through the generosity of friends of the University, encouragement has been given to both undergraduate and graduate work in the various branches, by establishing the following scholarships, prizes, bursaries, and medals.

A student will not be allowed to hold more than one of the following scholarships marked with an asterisk, but the published lists will show all those to which he would have been entitled, but for this provision. The Council may, at its discretion, award unallotted scholarships to the next eligible candidate.

Name	Years eligible	Amount	See page
*Baptie Scholarship	I	$100	148
*Harvey Aggett Memorial Scholarship	II	$75	148
*Boiler Inspection & Insurance Co. Scholarship	III	$150	149
*Jenkins Scholarship	III	$100	149
B.A.A.S. Medal	IV	....	149
Toronto Architectural Guild Medal	V	....	149
O.A.A. Scholarship	II	$100	149
Toronto Brick Company Prizes	IV	$75 & $25	150
Darling and Pearson Prize	V	$100	150
Heating and Ventilating Engineers Prize	III, IV	$25	150
E. I. C. Prize	III	$25	150
*Ceramics Scholarship	III	$50	150
MacLennan-MacLeod Memorial Prize	I	$25	151
J. A. Findlay Scholarships	II, III	....	151
R.A.I.C. Medal	V	....	151
*RansomScholarship in ChemicalEngineering	I	....	152
Rhodes Scholarships	II, III, IV	£400	152
Ubukata Fund	II	....	153
F. W. Jarvis Bursary	All	$50	153
U. of T. War Memorial Scholarships	All	$250	153
U. of T. War Memorial Fellowships	Graduate	$500	154
McCharles Prize	All & Grad.	$1,000	154
1851 Exhibition Science Research Scholarship	Graduate	£275	155
Nipissing Mining Co. Research Fellowship	Graduate	$1,100	156
Elizabeth Speller Memorial Fund	III, IV	....	166
Engineering Society Loan Fund	....	....	166
T. H. Bickle Bursary	All	....	157

SCHOLARSHIPS—*Continued*

Name	Years eligible	Amount	See page
The Engineering Society Semi-Centennial Award	III	$75	157
The Association of Professional Engineers of the Province of Ontario Bursary	II	$100	157
The 1923 Engineering Alumni Bursary	II, III	$150	157

NOTE: On account of the continued tendency towards lower rates of interest it is possible that the value of certain scholarships or prizes at the time of payment may prove to be less than the amount stated in the calendar.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that from the income a scholarship of One Hundred Dollars shall be awarded annually to an engineering student on the record of the First Year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship, up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the annual examinations of the First Year, enrolled in any one of the departments of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those departments. The first award was made on the results of the annual examinations of the Session 1925-26.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by the late Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of Seventy-five Dollars is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a scholarship in the Department of Mechanical Engineering of the value of One Hundred and Fifty Dollars to the student who obtains highest honour standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Bursar to the fees of the Fourth Year of the successful candidate.

JENKINS SCHOLARSHIP IN ENGINEERING

The Jenkins Scholarship in Engineering, presented by Jenkins Bros., Limited, has been donated to continue for a period of twenty years, the first award having been made in 1925.

This annual scholarship, of the value of One Hundred Dollars, is to be awarded to the student of the Third Year registered in one of the six departments of Civil, Mining, Mechanical, Chemical, Electrical, or Metallurgical Engineering, who has the highest aggregate of percentages for the First, Second, and Third Years.

B.A.A.S. MEDAL

A bronze medal has been donated by members of the British Association for the Advancement of Science, for students of the Faculty of Applied Science and Engineering. This medal will be awarded to the student of the Fourth Year, in any department, who, taking honours, obtains the highest aggregate percentage in practical and written examinations in the Year.

TORONTO ARCHITECTURAL GUILD MEDAL

The Toronto Architectural Guild was the organization of local architects from which sprung the Ontario Association of Architects. When the new and wider association became firmly established, the Guild disbanded and handed over to a trustee board certain funds for the establishment of a medal to be awarded in the School of Architecture of the University of Toronto.

The Trustee Board, now that the fund has accumulated considerably, announces its intention of awarding this medal annually to a senior student showing outstanding ability in Architectural Design.

ONTARIO ASSOCIATION OF ARCHITECTS SCHOLARSHIP

The Ontario Association of Architects offers a scholarship of One Hundred Dollars to the student of the Second Year in the School of Architecture who, at the annual examinations, obtains the highest honour standing in Architectural Design. The scholarship was awarded annually from 1928 to 1935 inclusive and has been extended for a further period of five years.

TORONTO BRICK COMPANY PRIZES

The Toronto Brick Company offers two prizes, one of Seventy-five Dollars and one of Twenty-five Dollars, to those students of the Fourth Year in the School of Architecture who win first and second places in a competition arranged by the Staff in the School of Architecture for this purpose.

DARLING AND PEARSON PRIZE IN ARCHITECTURE

Messrs. Darling and Pearson, Architects, offer annually a prize of One Hundred Dollars in books to the student in the final year of the School of Architecture who is assigned the highest marks in a special problem in Architectural Design, set for this purpose by the School of Architecture. The books constituting this prize are to be selected by the successful candidate, with the approval of the School of Architecture.

The first award of this prize was made in the Session 1927-28.

HEATING AND VENTILATING ENGINEERS PRIZE

The Ontario Chapter of the American Society of Heating and Ventilating Engineers offers an annual prize of Twenty-five Dollars, first awarded in 1931, for a period of five years, and extended indefinitely in 1935. The prize will be awarded to a student in either the Third or Fourth Year in any Department of the Faculty who, in the opinion of the Department of Mechanical Engineering, has written the most satisfactory thesis on a subject dealing with heating or ventilation, such thesis being prepared under special arrangements made by the Department of Mechanical Engineering, the result to be reported to the Council with the annual examination results. The thesis must be handed in not later than March 1st. The prize will not necessarily be awarded in any year.

Application should be made to the Department of Mechanical Engineering.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional knowledge among its members, offers an annual prize of Twenty-five Dollars in this University, to continue for a period of five years, commencing 1931, to the student who, in his Third Year in any one of the six Departments of Engineering, has proved himself most deserving as disclosed by the examination results of the year, in combination with his activities in the Engineering Society or with a local branch of another recognized engineering organization. This prize was extended in 1935 for a further period of five years.

CERAMICS SCHOLARSHIP

The Canadian Ceramic Society offers an annual scholarship of the value of Fifty Dollars for a period of ten years, commencing 1932, to be

known as "The Ceramics Scholarship." The scholarship will be awarded to the student in the Third Year in the Department of Metallurgical Engineering enrolled in the Ceramics Option, who has obtained the best academic standing. An award will not necessarily be made in any year.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize to the value of Twenty-five Dollars, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. In any year in which no award is made, the income from the prize of that year will be available for a second award in any subsequent year.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available to students in this Department, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession, and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award shall be made to another eligible student.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA MEDAL

The Royal Architectural Institute of Canada has presented a medal to be awarded annually to a member of the graduating class in the School of Architecture who, having completed the requirements for the degree, has

obtained high standing throughout his course and gives promise of being an architect of distinction after graduation. The person to whom the award is made must be a British subject; he must have completed the entire course in Architecture in the School of Architecture of the University of Toronto, except in the case of a graduate of the Royal Military College who shall have completed at least the Third, Fourth, and Fifth Years in the School; he must have obtained high standing throughout his course, particularly in Architectural Design, and his character, personality, and intellect must be such as to indicate that in the practice of his profession, he may be expected to attain distinction. No award will be made in any Session in which the Council of the Faculty of Applied Science and Engineering so recommends.

RANSOM SCHOLARSHIP IN CHEMICAL ENGINEERING

The Ransom Scholarship in Chemical Engineering is presented by A. C. Ransom, Esq., of Toronto, for the purpose of encouraging and giving financial assistance to students who choose the field of Chemical Engineering. This donation, consisting of $5,000, provides for a perpetual scholarship of an annual amount such as will be derived from the income of this sum. The first award was made on the results of the annual examinations of 1938.

The scholarship will be awarded annually to the student registered in the Department of Chemical Engineering who obtains the highest aggregate percentage of marks in the examinations of the First Year. The scholarship will be paid to the winner only if he proceeds to take his Second Year in the Department of Chemical Engineering in the University of Toronto.

THE RHODES SCHOLARSHIP

The Rhodes Trustees offer two scholarships for award annually in the Province of Ontario, each of the value of £400 a year and tenable ordinarily for three years.

Each candidate must be a British subject with at least five years domicile in Canada, and unmarried; he must have passed his nineteenth but not his twenty-fifth birthday on October 1st of the year for which he is elected; and he must have reached such a stage in his course at the University that he will have completed at least two years.

In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments;
(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship;
(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his fellows;

(4) Physical vigour, as shown by fondness for and success in outdoor sports.

Forms of application and full information regarding these scholarships may be obtained from the University Registrar and E. W. Ireland, Esq., 372 Bay Street, Toronto 2, Secretary of the Committee of Selection for the Province of Ontario. Selection is made in December each year for the scholarships for the year following. Application must be made to the Secretary on or before November 10th.

UBUKATA FUND

The S. Ubukata Fund, the gift of the late S. Ubukata, of the value of $10,000, provides for the establishment of prizes, medals, scholarships and loans for which Japanese students of all faculties and colleges may be eligible. Application must be made to the University Registrar on or before December 1st.

F. W. JARVIS BURSARY

The F. W. Jarvis Bursary, the gift of A. H. Jarvis, Esq., of Ottawa, brother of F. W. Jarvis, of the value of $50, to be awarded under the following conditions:

1. The bursary is open only to former students of Ottawa Collegiate Institute (Lisgar Street), who without some such assistance may not be able to carry on their academic courses.
2. It may be awarded at matriculation or in any year of an undergraduate course in any faculty of the University.
3. It may be held in successive years by the same student and is tenable with any other scholarship awarded by the University or federated college.
4. It shall be awarded on the recommendation of a committee of award consisting of the President of the University, the Principal of Ottawa Collegiate Institute and the donor. Application must be made to the University Registrar on or before May 15th.

UNIVERSITY OF TORONTO WAR MEMORIAL SCHOLARSHIPS

Four scholarships, each of the value of Two Hundred and Fifty Dollars, have been established by the Alumni Federation of the University from the War Memorial Fund to be awarded to students in the Faculties of Applied Science and Engineering, and Forestry.

The general basis on which scholarships may be awarded shall be as follows: (*a*) standing in course of studies. (*b*) need of assistance. (*c*) merit as shown in extra-academic activities—executive, literary, dramatic, athletic, etc. (*d*) such other qualifications of merit as may show themselves to the committee, including relationship, if any, to active service during the war.

Information regarding these scholarships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., to whom application for the same must be made before April 15th.

UNIVERSITY OF TORONTO WAR MEMORIAL FELLOWSHIPS

Two Fellowships of the value of $500 each, in the School of Graduate Studies of the University have been established by the Alumni Federation of the University of Toronto from the War Memorial Fund, to be awarded to graduates of any approved university in the Dominion of Canada enrolled, or intending to enrol in the School of Graduate Studies, for the purpose of proceeding to a degree in any department of the University of Toronto.

The general basis of award is as follows: (*a*) standing at graduation or in previous year of postgraduate work. (*b*) such other general qualifications of merit as may commend themselves to the committee, including relationship, if any, to active service during the war.

Information regarding these fellowships may be obtained from the Secretary-Treasurer of the Alumni Federation, 43 St. George St., to whom applications, accompanied by an official statement of undergraduate standing, should be made before March 1st.

MCCHARLES PRIZE

This prize was established in connection with the bequest of the late Æneas McCharles of Provincial Government bonds of the value of $10,000, and is awarded on the following terms and conditions, namely, that the interest therefrom shall be given from time to time, but not necessarily every year, like the Nobel prizes in a small way: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions, as passed by the Board of Governors, determine the method of award:—

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000.00) in money.

(3) The term "Canadian" for the purpose of this award shall mean any person Canadian born who has not renounced British allegiance; and for the purpose of the award in the first of the three cases provided for by the bequest, domicile in Canada shall be an essential condition.

(4) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(5) No prize shall be awarded for any discovery or invention unless the same shall have been proved to the satisfaction of the awarding body, to possess the special practical merit indicated by the terms of the bequest.

(6) The order of priority in which the three cases stand in the wording of the bequest shall be observed in making the award; that is, the award shall go *caeteris paribus* to the inventor of methods of smelting Canadian ores; and, failing such inventions, to the inventor of methods for lessening the dangers attendant upon the use of electricity; and only in the third event, if no inventors of sufficient merit in the field of metallurgy and electricity present themselves, to the inventor distinguished in the general field of useful scientific research.

(7) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIPS

The Royal Commissioners for the Exhibition of 1851 have invited the University of Toronto to recommend annually one or more candidates in order of merit for science research scholarships, each of the value of £275 per annum and ordinarily tenable for two years. The Commissioners may make a supplementary grant up to £30 per annum for University fees, etc., payable by the scholar during his tenure of the award.

Each candidate recommended must be a British subject, and under twenty-six years of age except in very special circumstances; he must have been a student of science in a university institution for a period of not less than three years and must have spent one full academic year at this University ending not more than twelve months prior to the date of recommendation.

The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

The scholar will be required to devote his whole time to research in some branch of pure or applied science at an institution in the United Kingdom or abroad, selected with the approval of the Commissioners.

The following are the departments of the University, the students of which are eligible to apply for these scholarships: 1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geology; 13. Mineralogy; 14. Physics; 15. Physiology; 16. Zoology.

A student shall not be deemed to be ineligible because of his being on the staff of the University, if he has not been in receipt of a salary of more than $800 per annum and the nominating board may, at its discretion, recommend candidates who have been in receipt of larger salaries provided that all other conditions are fulfilled.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nominating board consists of the following members appointed by the Senate:—the Chancellor, the President, the Provost of Trinity College, Dean Beatty, Dean Brett, Assistant Dean Ryerson, Dean Mitchell, Dr. C. S. MacInnes and Mr. N. F. Parkinson, and the Board shall have power to call to its aid as assessor any member of the teaching staff.

Applications for these scholarships must be submitted not later than April 15th to the University Registrar from whom copies may be obtained of the general regulations of the Commissioners governing the award and tenure of the scholarship.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering, to be known as The Nipissing Mining Company Research Fellowship, of the annual value of Eleven Hundred Dollars.

This Fellowship is open to graduates of any University.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller, of the class of 1893, the "Elizabeth Speller Memorial Fund" has been established, the annual income from which is available for loans to worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to

the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary of the Faculty.

THE T. H. BICKLE BURSARY

The T. H. Bickle Bursary is the gift of Mr. and Mrs. E. W. Bickle in memory of their son, T. H. Bickle, an undergraduate of Trinity College and a member of the Senior Intercollegiate Swimming Team at the time of his death in 1937. The income from the endowment of $1,000 will be awarded annually to a member of the Senior Intercollegiate Swimming Team of this University in any year or faculty. The Committee of Award shall consist of the Dean of the Faculty of Arts, the University Registrar, the Director of Athletics, and the Honorary Coach of Swimming. In awarding the Bursary the Committee shall consider the character, scholarship, and general interests of the members of the team.

THE ENGINEERING SOCIETY SEMI-CENTENNIAL AWARD

The Engineering Society Semi-Centennial Award, to the value of Seventy-five Dollars, was established in 1931 to commemorate the semi-centennial of the founding of the "School". The award is made to a student entering the final year.

The selection is based upon the following qualifications, which bear equal weight in the selection of the winner: *(a)* General "School" activities. *(b)* Contributions to the Engineering Society Executive Committee. *(c)* Personality, and social and athletic actvities. *(d)* Academic standing.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO BURSARY

The Association of Professional Engineers of the Province of Ontario, commencing 1939, offers a bursary of One Hundred Dollars to a student registered in the Second Year of the Department of Civil, Mining, Mechanical, Electrical, Chemical, or Metallurgical Engineering, or Engineering Physics, who obtains honours at the annual examinations, consideration being given to the financial need of the student in accordance with the desire of the Association to encourage needy students of outstanding ability.

THE 1923 ENGINEERING ALUMNI BURSARY

The Graduate Class of 1923 of the Faculty of Applied Science and Engineering has presented the 1923 Engineering Alumni Bursary, having the value of One Hundred and Fifty Dollars annually, commencing 1939.

This bursary is awarded annually to a student completing the Second or the Third Year; it may be awarded two years in succession to the same student, but will usually be awarded at the end of the Second Year. The award is made by a Committee of the Class of 1923, on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worth-while influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Payment is made in three instalments following registration in the next year.

Information may be obtained from the General Secretary, University Alumni Federation, 43 St. George Street.

SECTION XII. LIBRARIES AND LABORATORIES

LIBRARIES

THE UNIVERSITY LIBRARY

The University Library building is situated on the east side of the lawn that lies to the south of University College. It contains reading-rooms for men and for women, a law reading-room, and a medical reading-room, besides departmental studies which may be used as study rooms for honour students in the various departments in which the professors hold seminary courses, and private studies intended for advanced students engaged in research work.

The University Library building is open from 8.45 a.m. to 10.00 p.m. during the academic term. In the vacation, it is open from 9 a.m. to 4 p.m. (1 p.m. on Saturdays). Books in ordinary use may not be taken out of the Library building or from the reserved book reading-rooms during the day-time, but are lent for the night after 3 p.m., to be returned the following morning not later than 10 o'clock. Books not in general demand may, on application, be borrowed for a longer period.

DEPARTMENTAL LIBRARIES

Periodicals and other literature in the University Library of special interest to the students of this faculty have been housed in the Electrical, Engineering, Mechanical, and Mining Buildings for convenient reference. These departmental libraries are situated as follows:

Applied Physics	Room 22, Engineering Bldg.
Architecture	Room 37, Engineering Bldg.
Chemical Engineering	Room 53½, Mining Bldg.
Civil Engineering	Room 25, Electrical Bldg.
	Room 22, Engineering Bldg.
Electrical Engineering	Room 25, Electrical Bldg.
Geology	Room 74½, Mining Building
Mechanical Engineering	Room 17, Mechanical Bldg.
Metallurgical Engineering	Room 37, Mining Bldg.
Mining Engineering	Room 314, Mill Bldg.

LABORATORIES

CIVIL ENGINEERING LABORATORIES

There are four main divisions comprising these laboratories, namely: Cement, Highway, Soil Mechanics, and Mechanics of Materials.

CEMENT LABORATORY

The Cement laboratory contains all the appliances necessary in making the usual physical tests on Portland cement. It is supplied with cabinets and apparatus for individual work and various shot machines designed for tension and transverse tests. In addition, the laboratory is equipped with moulds, knock-down forms for beams, drying ovens, a curing room controlled for temperature and humidity, and other apparatus required in investigating the properties of aggregates and concrete mixtures.

HIGHWAY LABORATORY

The Highway laboratory is equipped to carry out investigations in bituminous and non-bituminous materials used in highway construction and maintenance. Among the more important pieces of apparatus are the Deval abrasion, the Page Impact, and the Dorry Hardness machines, a standard brick rattler, jaw crusher, diamond core drill with rock saw and grinding lap, bituminous extractor, viscosimeters, ductility and penetration machines, cementation test apparatus, electric ovens, constant temperature baths and special equipment for the determination of the properties of subsoils.

SOIL MECHANICS LABORATORY

The Soil Mechanics laboratory is supplied with apparatus designed for the investigation of the physical properties of soils. It contains a mechanical centrifuge for determining moisture equivalents, Dow liquid limit machines, consolidation and shear machines, Proctor compaction test apparatus, a penetration and bearing power machine, sampling tools, dispersind apparatus, hydrometers, etc. and a device for demonstrating the quicksand phenomena, permeameters.

MECHANICS OF MATERIALS LABORATORY

The Mechanics of Materials laboratory is available for the scientific and commercial testing of materials of construction such as iron, steel, timber, concrete, and masonry. The equipment includes a Riehle 400,000-lb. three screw power universal testing machine, with a capacity for beams and girders up to 28 inches in width and 16 feet in span, and for specimens in tension and compression up to 10 feet in length, a Riehle 200,000-lb. screw power universal testing machine, taking beams 18 feet in span, and tension and compression specimens up to 12 feet in length, a Riehle 100,000-lb. screw power universal testing machine, a Riehle 20,000-lb. screw power universal testing machine, an Olsen 20,000-lb. hand-power, wire testing machine, specially fitted for testing wooden columns with both fixed and pivoted ends, an Olsen 20,000-lb. hand-power universal testing machine, especially adapted for testing long columns, an Olsen torsion machine of 140,000 inch-pounds capacity for

testing the strength and elasticity of shafts and rods up to 2 inches in diameter and 10 feet in length; a hand-power torsion machine of simple mechanical design for testing short shafts of a maximum diameter of one inch, a Riehle 5,000-lb. transverse load testing machine for flexural tests of bars of wood and metal up to 48 inches in length, an Olsen 200-lb. tension testing machine, designed for the testing of textiles.

There are also special machines, such as an Olsen (Izod) pendulum impact machine; Brinell, scleroscope, and Firth Hardometer for hardness testing; an Avery repeated stress (fatigue) machine of the rotating beam type; proving levers and standard weights, an elastic ring, and an Amsler 60,000-lb. box, for calibrating purposes.

The accessory equipment includes Berry and Olsen strain gauges, a Nalder dividing engine, Beggs deformeter gauges, a Fereday-Palmer stress recorder—an instrument ideally suited for determining stresses in actual structures—apparatus for measuring angular deformation, a strainometer for use in determining Poisson's ratio.

In addition to the above, there are available a large number of strainometers of the usual degree of precision. These include the Bauschinger, Martens, Unwin, Ames, Riehle, Johnson, Huggenberger, De Forest scratch gauge, and other types.

MINING ENGINEERING LABORATORIES

During 1931 the building containing these laboratories was entirely rebuilt and greatly enlarged. The new building is 72 ft. x 100 ft., and is four stories high with a basement under half of it. The top floor and part of the third are occupied by the assaying laboratories. The rest of the building is given up to the ore dressing and mining laboratories, the commodious library and study rooms, lavatory and shower baths, rooms for the staff, two rooms for research in ore dressing, a model and map room, and storerooms.

ASSAYING LABORATORY

The East and West Fire Assay laboratories occupy the top floor of the Mill Building. They are identical, with preparation, furnace, and balance rooms in sequence, while between and common to these is a supply room, and another for chemical work. This arrangement allows a natural flow of operations from sample preparation to final weighing. Equipment in general is ample to give individual work to 32 students, thus encouraging original effort and conserving time.

The grinding rooms have a Sturtevant 2 x 6 jaw crusher, a McCool 8″ eccentric plate pulverizer, buck-boards, samplers, screens, and cupel machines. A special laboratory sampler gives samples of indisputable similarity, thus confining variations in students' assays, to their work.

Each furnace room has six Fletcher-Russell gas, and two D.F.C. oil furnaces. Parting cabinets have fan exhaust and direct illumination.

Each student is allotted a work place equipped with a pulp balance, weights, tools, fluxes, and locker for individual work.

The bead balances are modern instruments by Ainsworth, Becker, Heusser, Keller, Oertling, Thompson, and Voland. Some have special rider devices and a sensitivity of 0.002 milligram. Each has independent lighting and is mounted on a cork insulated pier.

A sample room houses a wide variety of ores, mill products, mattes, bullion, and alloys from typical mines and smelters. Thesis, service, and study rooms on the third floor provide facilities and equipment for student research. Two staff rooms are used for the determinations necessary for instructional purposes and for research. A Hoskins electric furnace with Leeds-Northrup controller and recorder is installed here. Other equipment includes pyrometers, microscope, electrolytic apparatus, and bullion rolls.

MINING LABORATORY

The Mining laboratory makes use of the ore dressing equipment as required. It is also equipped with an Ingersoll-Rand type ER-1 compressor and a variety of air driven rock drills representing the development of this machine. Blocks of synthetic ore for practising sampling and rock drilling are made up as required. A laboratory has been completed for the study of ventilation problems, air conditioning, dust counts, etc. In the main basement are bins for the accommodation of a large variety of ores from various mining districts.

ORE DRESSING LABORATORY

The main Ore Dressing laboratory, 72 ft. x 53 ft. x 22 ft. high, is equipped with the old five stamp battery with amalgamation plates, Wilfley table, Deister Plato table, Deister slime table, an old-fashioned buddle, and classifiers. Parallel with the stamp mill is a ball mill 30 in. x 24 in., which can be used alternatively with the stamps in connection with the concentrating tables. At one side of this main laboratory is apparatus representing the complete flow-sheet of a modern concentrator designed for continuous operation at the rate of 50 to 100 lb. per hour. This plant consists of feeders, two rod mills and a ball mill each 18 in. x 12 in., with classifiers, two Wilfley tables, a Dorr type thickener, a six-cell Fahrenwald Sub A flotation unit, a conditioner, a small pilot Wilfley table, and a Genter thickener. Another laboratory, 70 ft. x 25 ft., is set aside for batch work, and contains a variety of flotation machines, small ball and rod mills, small jigs, apparatus for cyanide tests and for tests in magnetic concentration. Other rooms are set apart for hand screening, microscopes, balances, a chemical room, and a room for roasting and other high temperature testing of ores in connection with ore dressing. For further research in ore dressing, there are available, Haultain Super-panners and Infrasizers, briquetting apparatus and metal lap machines

for the polishing of briquettes in the study of minerals and mill products. The laboratory is also equipped with a Panphot microscope and accessories.

The Crushing laboratory contains a Hadfield gyratory crusher, a set of rolls 16 in. x 12 in., two small Dodge crushers, two sets of miniature rolls, two disc grinders, and a dry screening machine of the Feraris type. Adjoining this room is a large room for practising sampling methods.

MECHANICAL ENGINEERING LABORATORIES

THERMODYNAMICS AND MECHANICAL LABORATORY

Instruction in this laboratory covers the examination and testing of steam engines and boilers, and of internal combustion engines of the Diesel and automobile type, as well as stationary power units. Experiments on the octane rating of fuels, heating values of coal, etc., and the action of injectors and heat transmission apparatus are made. On the mechanical side, experiments are made on static and dynamic balancing, belt testing, oil testing, etc.

The part of the building set apart for thermodynamics and mechanical work is the ground floor of a room 60 ft. x 155 ft. This room is lighted entirely from the roof in a perfect way. A part of the space 40 ft. wide running the entire length of 155 feet is served by a 3-ton travelling crane, and contains the following equipment:

50 h.p. Brown engine with separate jackets on both heads and barrel of cylinder.

Two-stage Rand air compressor having compound steam cylinders, each fitted with Meyer cut-off gear. The low pressure air cylinder has Corliss inlet gear.

30 h.p. high-speed Leonard tandem compound engine with shaft governor.

40 h.p. Uniflow engine.

25 h.p. General Electric steam turbine.

Two 15 h.p. Leonard engines with different types of valves, which are used for valve setting, presented by E. Leonard & Sons.

Centrifugal air compressor.

There are also two surface condensers with air pumps so arranged that any engine in the laboratory may be made to exhaust into the atmosphere through an open heater, or into one of the condensers, the change from one arrangement to the other being accomplished in a few minutes without the aid of valves.

The laboratory further contains:

A 3-ton York refrigerating machine with tanks.

An Amsler transmission dynamometer.

Apparatus for testing injectors and steam pumps.

Hot blast heating equipment.
Experimental air conditioning apparatus.
Numerous other pieces of apparatus and instruments.

The work on internal combustion engines is performed on the following:

14 h.p. National gas engine arranged for various compressions and points of ignition.

25 h.p. horizontal Diesel engine made by Ruston and Hornsby, especially arranged for testing.

25 h.p. Allen semi-Diesel engine.

25 h.p. tractor gasoline engine.

Six cylinder Chevrolet automobile engine. (Presented by the makers).

200 h.p. Sprague electric dynamometer.

Eight cylinder Ford automobile engine. (Presented by the makers).

Leyland six cylinder Diesel engine.

Hercules six cylinder engine for various fuels.

Standard C.F.R. fuel rating engine for finding the octane rating of fuels, etc.

Various accessories to above machines.

Steam for the laboratory is supplied by two 50 h.p. and one 100 h.p. Babcock and Wilcox boilers, the latter having an internal superheater. These boilers are located in a separate boiler room. They are used for experimental work only and are fitted up for testing. The gases pass up through two independent chimneys, and these have been arranged so that the draft and other conditions in the chimney at any point of its height may be examined.

In smaller work-rooms off the main laboratory are placed belt and oil-testing machines, and apparatus for testing the efficiency of machines.

A Carwen Olsen balancing machine for static and dynamic balancing testing has recently been installed.

HYDRAULIC LABORATORY

The Hydraulic laboratory is designed to give practical hydraulic experiments illustrating the laws of flow of fluids in pipes, through orifices, over dams, etc. Friction loss may be measured, and the action of various types of meters, with their coefficients, is examined. Measurements of the efficiency and best methods of operation of pumps, and of turbines of various types, are also determined and problems relating to water power development, also to the movement of fluids, find a place in this laboratory.

The laboratory occupies two floors, each 40 feet x 112 feet, and the apparatus therein may be briefly listed as follows:

Two 2-stage Gwynne centrifugal pumps, each for one cubic foot per second at 125 feet head.

Two 2-stage Escher Wyss turbine pumps, each for one cubic foot per second at 150 feet head.

These four pumps may be run in parallel for four cubic feet per second at 125 feet head, or in any desired series arrangement giving one cubic foot per second at not over 550 feet head, thus allowing for a wide range of experimental work.

A 125 h.p. Belliss and Morcom engine of 525 r.p.m. for driving the four pumps mentioned, and for experiment if desired.

A motor driven turbine pump for six cubic feet per second at 65 feet head for supplying the turbines.

An open trough five feet wide and 110 feet long for towing models and meters, and for certain types of open channel work.

A small reciprocating experimental pump.

A four stage motor driven turbine pump for experiments.

An Escher Wyss reaction turbine 13½ inches diameter, built specially for the laboratory.

A 24 inch Pelton turbine specially constructed for study.

A 12 inch Doble impulse turbine.

A reaction turbine with both Francis and propeller runners designed for this University.

An experimental centrifugal pump and meters.

A Kaplan turbine also made for test purposes.

A concrete and steel flume built primarily for research work on turbines.

A Moody spiral pump, motor driven, for a delivery of twelve cubic feet per second at low head.

A very carefully designed dynamometer and efficient set-up to enable reliable efficiency tests to be made with great accuracy.

A vertical steel tank 5½ feet diameter and 34 feet high to be used as a reservoir, also for experiments on nozzles, valves, meters, etc.

A weir tank 6 feet wide and 21 feet long with hydraulically operated valves.

Two measuring tanks of 240 cubic feet capacity, each mounted on accurate scales and to be used to calibrate the weirs or to weigh large quantities of water.

Three tanks, each 3 feet wide and 12 feet long, for experiments on orifices and weirs.

Six measuring tanks for calibrating the above orifices, etc.

A glass sided trough 30 feet long for studies on weirs, dams, and similar structures.

Venturi meter, hydraulic ram, Pitot tubes, numerous models, gauges, gauge tester, and all apparatus necessary for the above mentioned studies. The laboratory piping has been designed to give wide variety of operation of the system. Piping has been set up for friction and nozzle experiments and other work.

The laboratory is indebted to the Dominion Engineering Works, Montreal, and to Mr. William Inglis and others for generously supplying parts of the apparatus.

CHEMICAL ENGINEERING LABORATORIES

The Chemical laboratories are situated in the Mining Building, and are supplied with the usual modern equipment.

Seven large laboratories, each with its own balance room, and seventeen small laboratories are in steady use. Some of the latter are specially equipped for work in such fields as gas analysis, calorimetry, polarimetry, hydrogen ion investigations, and water analysis. A fireproof room is provided for work with volatile solvents and organic analysis, and special equipment for semi-micro analysis is permanently maintained. Nine of the small laboratories are set apart for undergraduate and graduate research, and a room is set apart for the construction of glass apparatus by the glassblower connected with the department, in which instruction in glassblowing is given to students. One of the large laboratories, approximately forty feet square, is equipped for the experimental study of chemical engineering and industrial chemistry. Among the apparatus installed there are: a stoneware column for the investigation of the absorption of gases by liquids, fractionating still, heat transfer apparatus filter press, vacuum evaporator, sulphonator, fusion pots, autoclaves, jacketed kettle, tanks, pumps, meters, and other necessary accessories. Each of these is used by undergraduates, and is further employed from time to time in research.

ELECTRICAL ENGINEERING LABORATORIES

The Electrical laboratories, located in the Electrical Building, are equipped for studies related to principles discussed in lecture courses rather than for routine tests.

The power services to all laboratories are 230-115 volts, direct current; 115 volts, three phase, 25 cycles; and 115 volts, three phase, 60 cycles. Power for the laboratories is supplied by the University Central Heating and Power Plant in the form of 230-115 volts, three wire, direct current. The alternating current services are supplied from two main motor-generator sets which are equipped with automatic voltage and speed regulators.

These different services, combined with a system of spare conductors, make it possible to conduct a great variety of experiments in any one of the laboratories. In all laboratories the measuring instruments are of the highest quality.

ALTERNATING CURRENT MACHINE LABORATORY

The Alternating Current Machine laboratory, located on the first floor, contains the main 25-cycle and 60-cycle service sets referred to above. For experimental purposes the following equipment is available: two 15 kva. motor generator sets, d.c. to 60-cycle a.c.; two 15 kva. motor generator sets, d.c. to 25-cycle a.c.; two 10 kva. 60-cycle phase displace-

ment dynamometer sets; a 25 H.P. low speed (322 r.p.m.) 60-cycle synchronous machine which produces an emf. wave very close to sine form; a 5 kw. 60-cycle synchronous converter; a mercury-arc rectifier; transformers; a.c. motors of all types; a model transmission line; two electromagnetic and two cathode ray oscillographs; and all necessary auxiliary apparatus.

DIRECT CURRENT MACHINE LABORATORY

The Direct Current Machine laboratory, located on the second floor, has a 40 kw. 230 volts d.c. to 115 volts d.c. motor-generator set with Tirrill regulator for special tests. Other equipment includes a number of 5 to 10 kw. motor-generator sets for d.c. generator tests; shunt, series and compound motors with and without interpoles; and other necessary apparatus such as loading racks, rheostats, circuit breakers, prony brakes and motor starters.

ELECTRICAL MEASUREMENTS LABORATORY

The Electrical Measurements laboratory, located on the top floor, is fitted with a convenient arrangement of power supply including a very flexible storage battery service and a 1000-cycle service in addition to the standard a.c. and d.c. services. The equipment includes galvanometers, resistance boxes, Wheatstone bridges, shunts, potentiometers, standard cells, bond testers, condensers, and such other apparatus required for making a great variety of studies in measurements by direct and alternating current methods.

COMMUNICATION LABORATORY

The Communication laboratory, located on the top floor, is equipped for setting up and measuring vacuum tube circuits of all usual types; and for measuring the properties of networks at both low and high frequencies. Cathode ray oscillographs, harmonic analyzers, amplifiers for bridge balance, etc., are available. A 1000-cycle supply of good wave form is located at all measuring points in the laboratory. A separate room is treated acoustically and equipped with the necessary apparatus for the study of electrical reproduction of sound.

SPECIAL LABORATORIES

A few smaller laboratories are set apart for particular studies. These include a high voltage laboratory with a 200,000-volt transformer and a 50,000-volt transformer complete with controls; a room with a specially designed model transmission line for the study of line characteristics, and a room with a small electric furnace for studies of the effect of temperature on materials from an electrical engineering point of view.

Study rooms are associated with the laboratories for design studies and engineering problems.

METALLURGICAL ENGINEERING LABORATORIES

These laboratories, in the east end of the Mining Building, occupy approximately 3,600 square feet on the basement floor and the same space immediately above on the ground floor. The basement floor is divided into one large furnace room, a small hydrometallurgical room, and two store rooms. The furnace room contains a motor driven Connersville blower, several gas-fired furnaces, two small blast furnaces, and a small six-hearth Wedge roasting furnace. The larger electric furnaces of the Department of Chemistry (Electrochemistry) are in this room. Some are supplied with direct current, others with alternating current from a 200 K.V.A. transformer. A system of flues, with hoods over all the furnaces, leads to a stack through which gases are pulled by a fan in the attic.

The hydro metallurgical room, in addition to apparatus for leaching tests, contains several natural draft furnaces and a large Hoskins resistance furnace. There are also tanks for electrolytic refining and precipitation of metals.

Situated in these two rooms, also, is most of the equipment used in the teaching of ceramics and non-metallic industrial materials. The apparatus includes a dry pan, a small dry press, a plunger machine with tile and hollow ware dies, an Abbé six-jar ball mill, a recuperative down draft clay testing furnace of brick construction, an oil-fired muffle decorating kiln, a small Seger test furnace, a high temperature oxygen acetylene furnace, a high temperature electric muffle furnace with a temperature range up to 1700° C, and standard screens, volumeters, elutriation apparatus, driers, and such sundries as are necessary for clay testing.

The upper floor is divided into laboratories, a library, store rooms, and offices. The laboratories are for metallurgical analysis; heat treatment and pyrometry; grinding, polishing, and etching; metallographic room, with two adjoining dark rooms.

The laboratory for metallurgical analysis is well equipped to give students training in mill and smelter methods, the analysis of ores, furnace products, ferrous and non-ferrous alloys, and specialized ceramic bodies

In the heat treatment and pyrometry laboratory there are a number of gas and electric furnaces, a Leeds and Northrup potentiometer, a disappearing filament pyrometer, a radiation pyrometer, a recording millivoltmeter, and thermocouples for use with millivoltmeter or potentiometer.

For grinding and polishing there are provided many sets of emery papers and six motor-driven polishing wheels.

The metallographic room is equipped with a horizontal Bausch & Lomb photomicrographic camera, a Leitz micro-camera attachment, two vertical cameras, and nine metallographic microscopes.

The laboratories also contain a Leeds and Northrup type "K" potentiometer for determining critical points, a Rockwell hardness testing machine, a Shore scleroscope, an emery cutting disc, and a mechanical saw.

APPLIED PHYSICS LABORATORIES

The Applied Physics laboratories, situated in the Engineering Building, are equipped as follows:

The Photometric laboratory is equipped with precision and portable photometers for the measurement of candle-power, illumination, and brightness; integrating spheres for determining the luminous output and efficiency of lamps and luminaires; and colorimeters, spectro-photometers, and flicker photometers for the measurement of colour. Standards of candle power, luminous flux, and colour temperature are maintained and a 132-volt storage battery with all electrical controls and meters necessary for precise photometry are provided.

The Illumination Design laboratory is equipped for demonstrating and measuring the performance of lighting installations.

The Optics laboratory is equipped with optical benches, etc., for the testing of lenses, and with examples of various optical instruments for instruction in their theory and applications.

The Photographic laboratory is equipped with cameras, dark rooms, and accessories for practical work in photography, and with sensitometers, spectrographs, and densitometers for the testing of photographic materials. A Zeiss phototheodolite, stereoscopes, stereocomparator, and plotting apparatus are provided for instruction in photographic surveying.

The Acoustical laboratory is equipped with the ordinary apparatus, such as forks, pipes, strings, etc., for illustrating the elementary laws of acoustics. There are also two rooms for work in sound transmission and absorption, equipped with an audio-frequency oscillator for the production of sounds of constant intensity, and microphones and amplifiers for reception.

UNIVERSITY SURVEY CAMP

In 1920 the University purchased approximately 175 acres of land, comprising a tract of field, woodland, and lake front property in the County of Haliburton, and erected permanent buildings for the use of students in Civil Engineering, Mining Engineering, Mining Geology, and Architecture, as well as for other students taking special work. The country is broken and rolling, and with the numerous small lakes and streams in the immediate vicinity, is admirably suited for work and the various problems that arise in practical surveying. The camp is at an elevation of about 1,000 feet above sea level and a secondary triangulation has been carried out, the stations of which are connected with the primary stations of the Geodetic Survey of Canada. Permanent bench marks have been established and connected up with the precise level net of Canada.

The Camp may be reached by the Canadian National Railways, via

Lindsay to Gelert, where conveyances are always on hand to drive direct to the camp by way of Minden, a distance of 12 miles.

The Camp, located 4 miles south of Minden, on the west side of Gull Lake, can be reached by road after leaving the main Provincial highway at Minden. There are four main buildings, including a Dormitory, Administration, Staff, and Dining Hall Building, which are suitably furnished and provided with electric lighting and drafting accommodation. Accommodation for 80 students can be provided, and a large proportion of the equipment of the Department is transported to the Camp for use during the summer session.

Mail, telegrams, or telephone messages should be addressed to "University Survey Camp, Minden, Ontario".

METROLOGICAL LABORATORY

The Department of Surveying and Geodesy is provided with all the ordinary field instruments, such as transits, levels, compasses, micrometers, sextants, planimeters, plane tables, tapes, chains, etc., with which is carried on the instruction in practical field operations as detailed elsewhere.

A small laboratory is also established in the basement of the observatory described below, containing the necessary instruments for the refined measurements of geodetic surveying; as, a standard yard and metre, a Rogers 10-foot comparator, an invar base measuring apparatus, a Kater's pendulum with vacuum chamber, a level trier, micrometer microscopes, etc.

The geodetic observatory in connection with this department is used for the instruction of students of the Fourth Year in taking observations for time, latitude, longitude, and azimuth by the precise methods used in connection with a geodetic survey. It contains a 10-inch theodolite and zenith telescope by Troughton & Simms; an astronomical transit instrument and an 8-inch theodolite by Cooke; two electro-chronographs; a Howard astronomical clock; a Dent sideral clock; a Dent sideral break-circuit chronometer; a wireless receiving instrument; arithmometers, etc.

AERODYNAMIC LABORATORY

The Aerodynamic Laboratory is fully equipped with an improved 4-ft. Royal Aircraft Establishment type wind channel, aerodynamic balance, micromanometers and other necessary instruments.

Air speeds of 80 feet per second can be secured in a stream of great steadiness and uniformity and higher speeds with some sacrifice in steadiness.

The work done in the Laboratory includes the investigation of problems in aerodynamics, tests of air craft components, and complete machinest rating of meters, ventilators, radiators, etc., and the study of the effec, of wind pressure on structures, chimneys, etc.

ONTARIO DEPARTMENT OF HEALTH LABORATORY

Through the courtesy of the Provincial Department of Health, the facilities of the well-equipped experimental laboratory, which the Department operates at Stanley Park (807 Richmond Street West), have been placed at the service of the University for the investigation of problems associated with all phases of Sanitary Engineering. Equipment and means are available for study and research in the various processes employed in sewage treatment, the different methods of water treatment, and the bacteriological and chemical examinations on water, sewage, air, milk, and all factors in sanitation.

ELECTROCHEMICAL LABORATORIES

The Electrochemical laboratories, which are situated in the Mining Building, are provided with special facilities for electrolytic work, including a large storage battery and electroplating dynamo with tanks, as well as a set of apparatus and electrical measuring instruments, for both undergraduate work and research. The experimental work on electric furnaces is carried out in a large furnace room in the basement, occupied jointly by the department of Metallurgical Engineering and the department of Chemistry (Electrochemistry). The equipment for this purpose comprises a 120 kw, 220 volt supply of direct current from the main power house through a switchboard, rheostats, circuit-breaker, and instruments to a set of distributing bus-bars, and a 200 Kva transformer stepping down from 2200 volts to 30-120 volts in 3 and 6 volt steps, which supplies alternating current at 25 cycles. There is a complete set of A.C. instruments, circuit-breakers, oil-switches, relays, automatic regulating winches, etc., and a Northrup high frequency furnace with its transformer is also installed. The two departments co-operate in the use of a Hoskin carbon plate furnace and a resistor tunnel furnace. Facilities for the study of high current carbon arcs and the thermal behaviour of refractories are also provided.

GEOLOGICAL LABORATORIES

The Geological laboratories are equipped for the study of geology from the modern viewpoint. Collections of rocks and minerals, models and natural specimens illustrating various geological features, topographic and geological maps for exercises in map reading, and fossils are all employed in the study of general geology. Typical index fossils are utilized, along with geological maps, in historical geology.

In the Economic Geology laboratory, numerous suites of specimens of ores and rocks illustrate the nature and occurrence of the deposits in many mining camps. A set of building stones, uncut, cut, and polished, is available for a course on that subject. These materials are studied megascopically and microscopically to determine the character and

associations of their mineral constituents. The Metamorphic Geology laboratory is supplied with specimens, thin sections, and petrographic microscopes for the study of metamorphic minerals and the changes that rocks undergo in thermal and dynamic metamorphism. Hand specimens and thin sections of suites of rocks from numerous Precambrian areas are also available for work in Precambrian geology. Facilities are available for sawing and polishing specimens of ores and rocks, and for making thin sections.

For work in structural geology, natural specimens and geological maps exhibiting complex structural conditions and structural problems illustrated by diagrams and drill logs, are extensively employed. For field methods in geology, the laboratories are supplied with geological and topographic maps, survey instruments, and various other equipment, so that work in the laboratory may supplement that in the field.

MINERALOGICAL LABORATORIES

The Mineralogical laboratories in the Mining Building provide facilities for most types of investigation involving minerals, crystals, and rocks.

Courses in laboratory work in the personal examination of type sets of named minerals, crystals, and rocks serve to illustrate the introductory lectures. More advanced work is provided in the identification of unknown minerals by physical tests, blowpipe, and other methods.

For the encouragment of pure crystallography, the laboratories are supplied with goniometers of the various types, crystal models, appliances for the cutting of oriented crystal sections and for their physical examination. Practical petrography is carried on in rooms provided with type sets of rocks, both macroscopic and microscopic. Advanced students are taught to make thin sections of rocks and polished sections of opaque minerals, and to study them microscopically.

The laboratory for the preparation of thin sections of rocks and minerals is provided with electric diamond saws and grinding appliances for the various types of work incidental to the preparation of thin sections. It is also equipped for the preparation of polished specimens for the microscopic examination of the opaque ore minerals.

The department is equipped with petrological and mineralographical microscopes, so that it is possible to provide advanced students with instruments and sets of thin sections and polished minerals for their own special use. Sets of index liquids and a universal stage are available for students interested in more advanced methods for determining the optical properties of crystals.

A well equipped X-ray laboratory, with suitable goniometers for the study of crystal structure, is available to qualified advanced students.

MUSEUM

The ROYAL ONTARIO MUSEUM, with exhibits in Archaeology, Geology, Mineralogy, Palaeontology and Zoology, is situated at the southwest corner of Bloor Street and Queen's Park.

Students of the University in all departments are recommended to avail themselves of the privileges of the Museum, which, although under separate control, is intimately connected with the work of the University.

The Museum is open on all week days from 10 a.m. to 5 p.m., and on Sundays from 2 p.m. to 5 p.m. The admission is free to the public on Tuesday, Thursday, Saturday and Sunday. On other days an admission fee of fifteen cents is charged.

By a resolution of the Board of Trustees all regular students of the University may be admitted free on all days of the week by presenting their card of registration.

SECTION XIII. DISCIPLINE

1. (*a*) There is vested in the Council of each federated university or college, and of each faculty, disciplinary jurisdiction over and entire responsibility for the conduct of their students in respect of all matters arising or occurring in or upon their respective buildings and grounds, including residences.

(*b*) Disciplinary jurisdiction in all other cases as respects all students is vested in the Caput.

(*c*) The Students' Administrative Council, in the discharge of all duties entrusted to it, will be supported in the due discharge of those duties by the disciplinary power of the Caput.

2. No student will be allowed to continue in attendance, whose presence is deemed by the Council of his college or faculty to be prejudicial to the interests of the University.

3. Students proceeding regularly to a degree are required to attend the courses of instruction and the examinations in all subjects prescribed for students of their respective standing, and no student will be permitted to remain in the University who persistently neglects academic work.

4. Unless special permission is granted by the Council of the faculty concerned, a student will not be permitted further registration in the University if, at the end of two sessions spent in the same year of the faculty in which he is registered, he has failed to obtain the standing necessary to qualify him for registration in the succeeding year of the faculty. An appeal from the decision of the Faculty Council may be made to the Senate.

5. All interference on the part of any student with the personal liberty of another by arresting him, or summoning him to appear before any tribunal of students, or otherwise subjecting him to any indignity or personal violence, is forbidden by the Caput and by the Councils of the colleges and faculties.

6. No initiation ceremony involving personal violence, personal indignity, interference with personal liberty, or destruction of property, may be held by the students of any college or faculty of the University, under the penalty of suspension or expulsion.

7. Any reception of the students of the first year in any college or faculty must be approved by the Council of that college or faculty, but such reception must not involve any infraction of the regulations of the two preceding paragraphs.

8. The organizing of a parade in the streets of the city, or the taking part in such parade without the permission of the authorities of the city on application of the Students' Administrative Council, will be regarded as a breach of discipline.

9. A student who is under suspension, or who has been expelled from a college or faculty or from the University, will not be admitted to the University buildings or grounds.

10. The constitution of every society or association of students in the Faculty of Applied Science and Engineering, and all amendments to any such constitution, must be submitted to and approved by the Council of the Faculty. All programmes of such societies or associations must, before publication, receive the sanction of the Council. Permission to invite any person not a member of a faculty of the University to preside at or address a meeting of any such society or association must be similarly obtained.

11. The name of the University is not to be used in connection with a publication of any kind without the permission of the Caput.

12. Students of any faculty or college on the premises of colleges or faculties other than those in which they are registered shall be subject to the regulations and penalties imposed by the administrative authorities of the premises concerned.

SECTION XIV. HART HOUSE

Hart House, the gift of the Massey Foundation, is so called in memory of Mr. Hart Massey. This House, which is for the use of men only, is far more than a students' club. In its widest interpretation it seeks to provide for all the activities in the undergraduate's life apart from the actual work in the lecture room.

Hart House contains under one roof a dining hall, common-rooms, library, debates room, music room, a small chapel together with rooms for the use of the Student Christian Movement, an art gallery, an arts and crafts room, photographic rooms, billiard room, gymnasia, swimming pool, running track, rifle range, and theatre.

The House is open from 8.00 a.m. to 11.00 p.m. daily and meals are served to students in the Great Hall. Members are entitled to full privileges of all rooms in the building between these hours and the use of the gymnasia, pool, showers and locker rooms until 6.30 p.m. each day except Saturday and Sunday, subject to the regulations of the Athletic Association. On Saturday the pool, together with the rest of the athletic wing, closes at 4.00 p.m.

The Warden is entrusted with the general supervision of the whole House, but the athletic wing is under the direct control of the Athletic Directorate. In great measure the care of the House and its welfare are entrusted to the students themselves. There are a number of committees, most of which consist of ten undergraduates, three senior members, and the Warden. The undergraduates on all these committees are elected annually by the undergraduate members of Hart House and the undergraduate secretaries of five of them (House, Library, Music, Art, and Debates) sit on the Board of Stewards which, together with certain appointed members, is the governing board of the House and directly responsible to the Board of Governors. Of this Board the Warden is ex-officio chairman. The Comptroller, the Assistant Comptroller, the Secretary, and the Assistant Secretary of Hart House are responsible for the administration.

All men undergraduates proceeding to a degree in the University are members of Hart House. The annual fee (September to May) is $12.00. To prevent the use of the building by unauthorized persons every member should carry his registration card and show it on request. Any member wishing to introduce a guest should obtain a card from the Warden's office.

Occasional students are not ordinarily eligible for membership in Hart House, but may make application to the Warden's office for election by the Membership Committee.

Graduate students, graduates resident in Toronto, and out of town graduates are entitled to the full privileges of Hart House when they have been duly elected and have paid the annual fee.

HART HOUSE THEATRE

Hart House Theatre is a repertory theatre existing to promote the interests of dramatic art in the widest sense. Its performances are open to members of the University and to the general public. The theatre is operated by a Board of Syndics, who are responsible to the Governors of the University for its administration. It is the policy of the Syndics to permit the rental of the theatre by those recognized dramatic societies within and outside the University which are endeavouring to do serious work.

THE SOLDIERS' TOWER

To commemorate the sacrifice of those graduates and undergraduates of our University who gave their lives in the Great War (1914-1918), the graduates have erected the Soldiers' Tower. Situated at the southwest corner of Hart House, the Tower rises—a symbol of sacrifice—and with its screen forms a majestic link between Hart House and the old Main Building. Beneath the sheltering arches of the screen, the names of the six hundred and eighteen, to whom the memorial pays its proud and affectionate tribute, are cut deep in the stone. Above, in the belfry of the Tower, is a carillon that, as it chimes, weaves a fabric of memories for professors and students who take up the tasks laid down by those who fell.

SECTION XV. STUDENT ORGANIZATIONS

THE STUDENTS' ADMINISTRATIVE COUNCIL

The Students' Administrative Council is composed of the President and Head of the recognized men and women student organizations in each of the colleges, faculties and departments of the University, as outlined in Article 4 of the Constitution. The Students' Administrative Council assumes responsibility for the publication of The Varsity, Torontonensis, and the Students' Handbook. It represents the students at University functions and on public occasions, and receives and administers all funds accruing from Student Council fees, revenues from publications and such other funds as shall become the property of the Students' Administrative Council; and through its secretaries it organizes such intercollegiate and University activities as may be of interest to the student body as a whole.

The University band and the symphony orchestra, as well as inter-university debates, are organized and administered by the Students' Administrative Council. The sale of official University rings, pins, crests, etc., and orders for official blazers are also in the hands of the Council. In addition, the Council operates an employment bureau for men and women undergraduates for summer, Christmas, and part-time work. It operates a loan fund for men and women undergraduates in the final two years of their courses. Applications for loans must be made to the Students' Administrative Council's office in January of each year. It operates, as well, a housing service for men students.

The annual fee paid by all undergraduates proceeding to a degree, provides for a year's subscription to "The Varsity" and entitles the student to a copy of "Torontonensis" upon graduation, and also to a copy of "The Students' Handbook" at the beginning of each Michaelmas term. The fee also covers administrative costs of the Students' Administrative Council.

UNIVERSITY OF TORONTO ATHLETIC ASSOCIATION

By the authority of the Board of Governors University athletics for men are under the control of the University of Toronto Athletic Association of which the executive body is the Athletic Directorate consisting of:

- the President of the University,
- two members of the faculty, appointed by the President,
- two graduates, appointed by the Athletic Advisory Board,
- the Medical Director, the Athletic Director and the Financial Secretary (*ex-officio*),
- five undergraduates, elected annually, from the student body,
- an undergraduate representative, appointed by the Men Students' Administrative Council.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with men's athletics, and no men's athletic event can be held in the University without its approval. It has full control and direction of the gymnasium, the swimming pool, the locker rooms, showers and other conveniences in connection with athletics in Hart House, the athletic fields, stadium and ice arena. The Directorate is empowered by the Board of Governors to make the necessary arrangements to effect the carrying out of the University regulations requiring Physical Training for men. The annual athletic fee, subject to certain limitations, provides for the opening of the gymnasium and swimming pool at nights, permits each student to attend home games of the University football and hockey teams, and offers other privileges such as skating at the outdoor rink and affiliation with golf, riding and ski-ing clubs, etc.

UNIVERSITY OF TORONTO WOMEN'S ATHLETIC ASSOCIATION

By the authority of the Board of Governors University athletics for women are under the control of the University of Toronto Women's Athletic Association of which the executive body is the Women's Athletic Directorate consisting of:

- the President of the University,
- two women members of the faculty, appointed by the President,
- two women graduates, elected by the Women's Athletic Advisory Board,
- the Medical Adviser for Women, the Physical Directress, and the Financial Secretary (*ex-officio*),
- five women undergraduates, elected annually.
- one woman undergraduate, appointed by the Students' Administrative Council.

The Directorate alone has the power to sanction the use of the name "The University of Toronto" in connection with women's athletics, and no woman student may participate in any athletic event during the academic year without its permission. The Medical Adviser for Women and the Physical Directress are authorized to arrange for such Physical Training for women as is required by the University. The annual athletic fee, subject to certain limitations, permits each student to attend home games of the University football and hockey teams, and offers other privileges such as skating at the outdoor rink and affiliation with golf, riding and ski-ing clubs, etc.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

The objects of the Engineering Society as set forth in its constitution are:

(*a*) The encouragement of original research in Engineering,
(*b*) The preservation of the results of such research,

(*c*) The dissemination of these results among its members,
(*d*) The cultivation of the spirit of mutual assistance and co-operation among the members of the Society in the preparation for, and in the practice of, the profession of Engineering.
(*c*) To afford an official means of communication between the Student body and the Faculty Council, the University authorities, and the students of other Faculties.

For purposes of organization the Engineering Society consists of a federation of the clubs named as follows:

(*a*) The Civil Club of the Engineering Society, composed of the undergraduates in Civil Engineering.
(*b*) The Mining and Metallurgical Club of the Engineering Society, composed of the undergraduates in Mining Engineering, Metallurgical Engineering and Mining Geology.
(*e*) The Mechanical Club of the Engineering Society, composed of the undergraduates in Mechanical Engineering.
(*d*) The Electrical Club of the Engineering Society, composed of the undergraduates in Electrical Engineering.
(*e*) The Architectural Club of the Engineering Society, composed of the undergraduates in Architecture.
(*f*) The Industrial Chemical Club of the Engineering Society, composed of the undergraduates in Chemical Engineering.
(*g*) The Engineering Physics Club of the Engineering Society, composed of the undergraduates in Engineering Physics.
(*h*) The Debating Club of the Engineering Society, composed of the undergraduates in all Departments.

These Clubs devote themselves to subjects of special interest to their members. Each club holds meetings at regular intervals, when papers are read, and discussions on technical subjects take place.

The Society meets during the academic year (except in April). Addresses are given by prominent men on subjects of general interest.

The Society publishes an annual, called "Transactions", which contains addresses given at the meetings and an account of the year's activities.

A Supply Department is conducted by the Society on a co-operative plan, through which instruments, draughting supplies, stationery, and other supplies, can be purchased.

FACULTY OF APPLIED SCIENCE ATHLETIC ASSOCIATION

Affiliated with the Engineering Society is the Faculty of Applied Science Athletic Association.

The Athletic Association has full control over all athletic clubs using the name of the Faculty of Applied Science. The Executive Committee has power to suspend anyone from the privileges of membership in the Associa-

tion for any breach of its regulations, and controls the finances of all athletic clubs in the aforesaid Faculty. The annual membership fee of this Association is two dollars.

No other moneys are collected for the support of athletics in the Faculty of Applied Science without the sanction of the Executive Committee.

STUDENT CHRISTIAN MOVEMENT

The Student Christian Movement in the University of Toronto is part of an international fellowship of students in the colleges and universities of the world.

It is a fellowship, based on the conviction that in Jesus Christ are found the supreme revelation of God and the means to the full realization of life. It seeks, through study, prayer, and practice, to understand and follow Jesus Christ and to unite in its fellowship all students who share its basic conviction as well as those who wish to test its truth.

Some of the means employed by the Movement in realizing its purpose are study groups, worship services, forum discussions, conferences, lectures and addresses by prominent religious leaders, and social service in the downtown district. It is not necessary to "join" in order to share in the programme of the Movement. Its activities are open to all.

Full information may be had from the S.C.M. executives in the various Colleges, or from the General Secretaries of the S.C.M.: Rev. W. C. Lockhart, Hart House, and Miss C. M. Brown, Household Science Building. The names of the executives will be found in the Students' Handbook.

CANADIAN OFFICERS TRAINING CORPS

The University of Toronto Contingent of the Canadian Officers Training Corps provides for university students, the opportunity of obtaining War Office certificates of qualification as officers in the Canadian Militia and other Empire forces. This, apart from graduation from R.M.C., is the only means by which such qualifications can be obtained without first being appointed a provisional officer in a Militia unit.

Students in the Faculty of Applied Science and Engineering may train and qualify in Artillery, Survey, Engineering, Signalling, and Infantry, thus obtaining practical instruction which is most closely allied with and complementary to their more academic University course.

Most of the officers of the Contingent are selected from undergraduate members of the Corps, and members holding certificates of qualification are eligible, if recommended, to attend summer camps of instruction in various branches of the Services. Numbers of our graduates, holding certificates of qualification, have obtained permanent commissions in the Royal Canadian Air Force, the Canadian Militia, Imperial Army, Indian Army, and Royal Air Force.

University credit in Physical Training (compulsory in the first two years of attendance) is granted to members of the Corps who complete the annual training in the Contingent.

The Contingent headquarters are at 184 College Street, and include armouries, members' reading room, library, and lecture rooms.

The Contingent Staff is:

Officer Commanding............Lieut.-Col. H. H. Madill, V.D., m.s.c.
Second in Command..............................Major W. S. Wilson
Adjutant..Capt. L. F. Koyl
Paymaster................................Major T. A. Reed, E.D.
Quartermaster................................Capt. E. G. Moogk
Medical Officer.............................Major D. L. MacLean
Chaplain..
Contingent Sergeant-Major.....S-M. W. Hunt, late Royal Welch Fusiliers
Company Commanders:
"A" Co.......................................Capt. W. E. Carswell
"B" Co...Capt. R. D. Barron
"C" Co. (Applied Science)..............Major M. B. Watson, m.s.c.
"D" Co.......................................Capt. F. R. Crocombe

SECTION XVI. LODGING AND BOARD

GENERAL

Accommodation is readily obtainable in numerous private boarding-houses within a short distance of the University, at a cost of from ten dollars a week upwards, and board obtained separately at about seven dollars per week. A list of accredited boarding-houses is kept by the Secretary of the Students' Administrative Council in Hart House and students are recommended to consult him with reference to the selection of suitable accommodation.

RESIDENCE FOR MEN

Through the generosity of the late E. C. Whitney, Esq., Mrs. Whitney and friends, the University offers to approximately one hundred and fifty men the advantages of residential life within its own grounds. The Residence consists of three Houses: South, East, and North.

The regular rates are $3.25 a week for a single room or half of a suite (two bedrooms and common study). For men holding matriculation or undergraduate scholarships, for first class honour men in the Faculty of Arts, and for honour men in the other faculties, the rates are $3.00 a week. An occupant entitled to the lower rate must, when paying his rent, submit to the Bursar the evidence that he has the required standing. A student of the Faculty of Arts requiring this evidence may obtain it in the form of a certificate from the University Registrar, Simcoe Hall; a student of any other Faculty may obtain it from the Secretary of his faculty.

Except under very special circumstances, occupants who withdraw at any time during the Michaelmas term will be required to pay the full rent for that term. Occupants who obtain permission to withdraw during the Easter term will be required to give two weeks' notice and to forfeit their deposits.

Applications for rooms must be submitted to the Secretary of the Residence Committee, Registrar's Office, Simcoe Hall. Forms for this purpose will be supplied on request. Each application must be accompanied by a deposit of $5.00. This deposit will be returned if the applicant is not admitted, but will be forfeited by the applicant if notification, in writing, of his refusal to accept the room assigned is not received by the Secretary before September 15th. On request the deposit will be refunded in full at the end of the college year if the room key is returned and the room and furniture left in a satisfactory condition.

The University lays down three general rules designed to prevent hazing, gambling, and the use of intoxicants.

A circular giving further information may be obtained from the Secretary of the Residence Committee.

SUMMARY OF STUDENTS IN ATTENDANCE

Session 1938-39

	Department										
Year	1	2	3	4	5	6	7	8	8a	9	Total
I	19	34	81	11	23	80	40	19	5	7	319
II	26	34	45	3	12	49	29	18	..	9	225
III	14	41	29	3	10	47	34	31	1	2	212
IV	17	29	20	1	6	52	22	14	..	2	163
V	..	..	..	6	..	..	..	..	..	..	6
	76	138	175	24	51	228	125	82	6	20	925

For graduate students, see p. 191.

SECTION XVII. THE ENGINEERING ALUMNI ASSOCIATION

The University of Toronto Alumni Federation exists to continue those very valuable associations formed as an undergraduate and to do everything in its power to further the interests of the undergraduates, the graduates, the Faculties and Colleges, and the University as a whole. The organization of the Alumni follows very closely that of the University. There are seventeen associations, each drawing its membership from one of the Colleges, Faculties, or Departments of the University. To get full co-ordination and co-operation among these various associations, a Federation, known as the Alumni Federation of the University of Toronto, was formed some years ago.

The governing body of the Federation, the Board of Directors, is composed of an Honorary President, a President, a Vice-President, thirty-two Dierctors, and a Secretary-Treasurer. The Secretary-Treasurer is a paid permanent member of the Federation. He is in charge of the office maintained at 43 St. George Street to look after the clerical work of the various Associations and the Federation, and to arrange for the publication of the University of Toronto Monthly. The thirty-four Directors are appointed or elected from the various Associations and their tenure of office is from one to three years. The President is elected for one year, and may be a member of any one of the constituent Associations. The Vice-President is elected in the same manner, and either President or Vice-President may come from the Alumni or Alumnae at large.

The governing body of the Engineering Alumni Association is known as the Council. It is composed of a President, Past President, three Vice-Presidents, Secretary, Treasurer, six councillors resident in the city, two out-of-town councillors, the six Engineering Alumni representatives on the University Senate, Federation representatives, and the President of the Engineering Society. The councillors are elected for a term of three years.

Much of the work of promoting the interests of the Faculty in general, graduate and undergraduate, is carried out through the regular committees of the Engineering Council. These are Executive, Membership, Publicity, Scholarship, Undergraduate Relations, Reunions, Engineering Education, Federation Affairs, and Award of Merit. From time to time special committees are also formed as occasion demands.

The Association is composed of all "School" graduates and all students who have proceeded as far as their Second Year in the Faculty before leaving for any reason. They are all members of the Association, whether paid-up or not, but are only members of the Federation when they have paid their annual fees. The fees at the present time are on a graduated scale. For the first year after leaving the "School" the fee is one dollar, for the second year two dollars, and after that the regular fee is three

dollars. The distribution of this fee may be of some interest. One dollar goes to the Association's general funds and the other two dollars to the Federation to cover the cost of the clerical work involved in the running of the Association, its share of the Federation expenses, and the cost of producing and distributing the University of Toronto Monthly, which is sent to every paid-up member for nine months of the year, from October to June.

APPENDIX. GRADUATE STUDIES

Graduates interested in pursuing courses for post-graduate degrees should send inquiries to the Secretary of the School of Graduate Studies.

AERONAUTICS

The University is equipped with a four-foot wind tunnel in a specially designed building; and, so far as the facilities permit, properly prepared graduates will be admitted for private study, or for a course leading to an advanced degree (M.A.Sc. or Ph.D.)

Graduates who wish to undertake this work should apply to the Committee Administering the Wind Tunnel; and, if they are candidates for an advanced degree, should also register with the Secretary of the School of Graduate Studies, in accordance with the conditions laid down in the Calendar of that School.

REGULATIONS FOR DEGREES

MASTER OF APPLIED SCIENCE, MASTER OF ARCHITECTURE

The regulations governing the Degrees of Master of Applied Science (M.A.Sc.) and Master of Architecture (M.Arch.) shall be determined as follows:

1*a*. A candidate for the degree of Master of Applied Science shall hold the degree of Bachelor of Applied Science of this University or a degree from some other university recognized as equivalent by the Council of the School of Graduate Studies.

1*b*. A candidate for the degree of Master of Architecture shall hold the degree of Bachelor of Architecture or the degree of Bachelor of Applied Science in Architecture of this University or a degree from some other university recognized as equivalent by the Council of the School of Graduate Studies.

2. A candidate wishing to proceed to a graduate degree shall (*a*) register with the Secretary of the School of Graduate Studies at the beginning of the academic year, (*b*) enrol in one of the departments mentioned in Clause 4. As a condition of registration as a candidate proceeding to a degree, he must submit evidence that the department concerned is willing to enrol him.

3. Not later than November 1, 1939, he shall submit to the Secretary for acceptance by the Council of the School of Graduate Studies the title of his proposed thesis as approved by the department concerned.

4. Not later than May 15th, 1940, he shall present evidence to the Council of the School of Graduate Studies that he has spent not less than one academic year in the department concerned as a student enrolled

in one of the following departments on a course of study approved by the department: Civil Engineering, Mining Engineering, Mechanical Engineering, Architecture, Engineering Physics, Chemical Engineering, Electrical Engineering, Metallurgical Engineering, Mining Geology.

5. Not later than May 15th, 1940, evidence that the candidate has satisfactorily met all the requirements of the department with regard to thesis and to such examinations as the department shall require, shall be forwarded to the Council of the School of Graduate Studies through the sub-committee administering the regulations governing the degrees of Master of Applied Science and Master of Architecture.

CIVIL ENGINEER, MINING ENGINEER, MECHANICAL ENGINEER, ELECTRICAL ENGINEER, CHEMICAL ENGINEER, METALLURGICAL ENGINEER

The regulations governing the Professional Degrees of Civil Engineer (C.E.), Mining Engineer (M.E.), Mechanical Engineer (Mech.E.), Electrical Engineer (E.E.), Chemical Engineer (Chem.E.), Metallurgical Engineer (Met.E.), for the session 1939-40 shall be determined as follows:

1. A candidate for one of the said degrees shall hold the diploma of the School of Practical Science or of the Faculty of Applied Science and Engineering or the degree of Bachelor of Applied Science, or shall have spent not less than two years as a member of the teaching staff in this Faculty after having graduated in engineering from another institution of recognized reputation.

2. He shall have spent at least three years after receiving the diploma or the degree in the actual practice of the branch of engineering wherein he is a candidate for a degree.

3. Intervals of non-employment, or of employment in other branches of engineering, shall not be included in the above three years. It shall not be necessary that the several periods requisite to make up the said three years be consecutive.

4. The candidate shall obtain from the Secretary of the School of Graduate Studies the regular application form which, properly filled out, accompanied by the designated evidence of professional experience and by the title and synopsis of the proposed thesis, shall be delivered to the Secretary not later than the first day of November.

The evidence of professional experience shall fully describe the kind and extent of all work undertaken by the candidate since the date of graduation up to the time of application, indicating clearly the degree of responsibility for such work. Certificates from present and past employers shall accompany the application. The names and addresses of not less than five engineers to whom the candidate is personally known and who have knowledge of his professional activities shall be submitted.

5. The application and the subject of the thesis are subject to the approval of the Board of Examiners, who may satisfy themselves by oral or written

examinations in regard to the candidate's experience and competence in engineering works.

6. The candidate after notification of the approval of the Board shall prepare an original engineering thesis in the branch in which he has applied for a degree. This thesis shall be on work in which the candidate has had actual experience and shall preferably be in the form of an engineer's report on the design of engineering works, or on processes, and accompanied by all necessary descriptions, details, drawings, bills of materials, specifications and estimates. (Note that a thesis of a solely descriptive type will not be acceptable.)

7. The thesis, with accompanying papers, described in clause 6, shall be sent to the Secretary not later than the first day of March.

8. The candidate may be required to present himself for examination in the months of March or April at such time as may be arranged by the Examiners.

9. The thesis, drawings and other papers submitted under clause 7, shall become the property of the University.

10. Nothing in these regulations shall prevent any candidate from receiving more than one of the said degrees, provided he has the necessary qualifications for each degree. An interval of three years must elapse between the granting of any two degrees under these regulations.

DOCTOR OF PHILOSOPHY

Graduates of the Faculty of Applied Science and Engineering may proceed to the degree of Doctor of Philosophy. Information as to the conditions to be met by candidates for this degree is to be found in the Calendar of the School of Graduate Studies, which may be obtained from the Registrar of the University. The degree is an academic degree, not a professional one, and the research work and courses leading to the degree are primarily concerned with the fundamentals and underlying principles of the sciences. In general, a candidate selects one major and two minor subjects for study, the research being carried out in the major subject. A period of three years is usually required for the fulfilment of the requirements for the degree. However, it should be understood that the degree is not granted for the passing of prescribed courses or for the performance of prescribed laboratory work for a period of three years. The laboratory research work must have led to results of a high order, constituting a real contribution to the science of the major subject, and the candidate must have attained a decided maturity of knowledge and outlook before he may present himself for final examination by the Committee of the School of Graduate Studies. A graduate proposing to proceed to this degree should consult, in the first instance, with the members of the staff in the department in which he proposes to take his major subject.

A list of major and minor options in the Department of Chemical Engineering and in the Department of Mechanical Engineering are to be found in the Calendar of the School of Graduate Studies.

HIGH SCHOOL ASSISTANTS' CERTIFICATES

The Department of Education of Ontario has agreed to accept the degree of Bachelor of Applied Science as fulfilling the academic requirement for admission to the course for a High School Assistants' certificate in the Ontario College of Education.

SPECIALISTS' CERTIFICATES

By an agreement between the University of Toronto and the Department of Education of Ontario, persons holding the degree of Bachelor of Applied Science may, by taking certain prescribed courses in the Faculty of Arts, complete the academic requirements for admission to the qualifying examination for specialist courses in (*a*) Mathematics and Physics and (*b*) Science, at the Ontario College of Education. Information regarding these prescribed courses may be obtained from a pamphlet issued by the Registrar of the University, from whom copies may be had on application. Each person who desires to complete these academic requirements should communicate directly with the Registrar in order that his case may be considered and his particular conditions defined.

The Department of Education has approved of the acceptance of the degree in Applied Science in the Department of Engineering Physics, with standing of at least 60% at the final examination, as covering the academic requirements for admission to the qualifying examination for the Specialists' course in Mathematics and Physics at the Ontario College of Education.

ONTARIO LAND SURVEYORS AND DOMINION LAND SURVEYORS

Examinations are held usually in February of each year, for the following:

- Preliminary Dominion Land Surveyors
- Leveller's Examination
- Final Dominion Land Surveyors
- Ontario Land Surveyors

Any student of the Faculty of Applied Science and Engineering is eligible for these examinations, but graduates in Civil and Mining Engineering are allowed a shortened apprenticeship before writing their final examinations. Full information respecting above examinations may be obtained from the staff in Surveying and Geodesy.

GRADUATES ENROLLED IN THE DEPARTMENTS OF THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Civil Engineering, Municipal and Structural	3
Civil Engineering, Surveying and Geodesy	1
Chemical Engineering	17
Electrical Engineering	
Engineering Physics	2
Mechanical Engineering	1
Metallurgical Engineering	2
Mining Engineering	2
Total	28

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